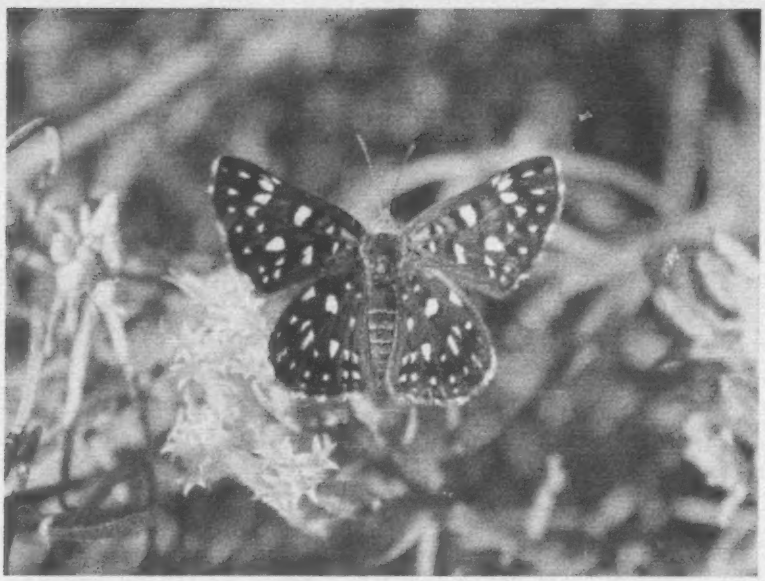
COSEWIC
Assessment and Status Report

on the

Mormon Metalmark
Apodemia mormo

Southern Mountain population
Prairie population

in Canada



Southern Mountain population - ENDANGERED
Prairie population - SPECIAL CONCERN
2014

COSEWIC
Committee on the Status
of Endangered Wildlife
in Canada

COSEPAC
Comité sur la situation
des espèces en péril
au Canada

COSEWIC status reports are working documents used in assigning the status of wildlife species suspected of being at risk. This report may be cited as follows:

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COSEWIC
Assessment Summary

Assessment Summary – May 2014

Common name
Mormon Metalmark - Southern Mountain population

Scientific name
Apodemia mormo

Status
Endangered

Reason for designation
This butterfly is found in very small numbers within small habitat patches in the narrow valley bottoms of the Similkameen and Okanagan valleys of southern British Columbia. The valley bottoms are also an important transportation and utility corridor, and the butterfly is threatened by road maintenance and other land development activities, as well as the growth of invasive plants that shade out their host plants.

Occurrence
British Columbia

Status history
Designated Endangered in May 2003. Status re-examined and confirmed in May 2014.

Assessment Summary – May 2014

Common name
Mormon Metalmark - Prairie population

Scientific name
Apodemia mormo

Status
Special Concern

Reason for designation
This butterfly occurs in the remote badlands and grassland habitats of Grasslands National Park and adjacent community pastures. Because of extensive surveys in the last decade, the known population of this butterfly is now large enough that it no longer meets the criteria for Threatened. There are few direct threats to the butterfly, although the slow spread of non-native plants that may compete with host plants and overgrazing in areas outside of the park are of concern and may impact habitat quality.

Occurrence
Saskatchewan

Status history
Designated Threatened in May 2003. Status re-examined and designated Special Concern in May 2014.

COSEWIC
Executive Summary

Mormon Metalmark
Apodemia mormo

Southern Mountain population
Prairie population

Wildlife Species Description and Significance

Mormon Metalmark, *Apodemia mormo* (Family Riodinidae) is a small butterfly (wingspan 25 to 32 mm) that is dorsally dark brown and ventrally grey, with white spots and black marks on the wings. The central forewings are orange on both dorsal and ventral surfaces. The larvae are up to 25 mm long, dark purple with yellow spots, and clumps of black bristles.

Distribution

The Canadian range is represented by two disjunct populations. The Southern Mountain Population is restricted to south-central British Columbia (BC) and the Prairie Population restricted to southwestern Saskatchewan (SK) (Prairie Population). In BC, the butterfly occurs in the Similkameen Valley from the international border to Olalla and west to Keremeos. It is also known from one extant site in the south Okanagan Valley near Osoyoos and historically as far north as Okanagan Falls. Within this range it occupies an area of less than 50 ha in small, scattered sites at low elevation (450-680 m above sea level). In SK, Mormon Metalmark is found in the East and West Blocks of Grasslands National Park, and a few adjacent private properties and community pastures.

Habitat

Mormon Metalmarks are associated with open, arid habitats that support the larval host plants, buckwheats. The Southern Mountain Population is primarily found on eroding sandy-gravelly and rocky slopes with Snow Buckwheat. These include natural hillsides and human-modified habitats such as roads and transmission rights-of-way, railway embankments, and gravel pits. The Prairie Population is typically associated with Few-flowered Buckwheat and Rubber Rabbitbrush, the larval host plant and main adult nectaring source respectively. They can be found on eroding, clay slopes in the prairie badlands, as well as more level terrain.

Biology

In Canada, Mormon Metalmarks have one generation per year. Eggs or early instar larvae overwinter in the soil or at the base of their larval host plants. The species has five larval instars and pupates for several weeks in July, within debris near the base of host plants. The adult flight period is from late July until late September with a peak in mid- to late August. Individual adults live about 10 days and primarily nectar on Stinking Rabbitbrush and the larval host plant. The maximum dispersal in the Southern Mountain Population is estimated as 4 km but for most individuals is probably less (< 100 m).

Population Sizes and Trends

Population sizes and trends are poorly known for both the Southern Mountain and Prairie populations. Survey effort in both DUs in the last decade has resulted in new sites. Sites resurveyed show abundance varies yearly. The population size of the Southern Mountain DU is estimated to be at least 2000 individuals in 2006 compared to less than 100 in 2002. At least one historic site has been lost in the Okanagan Valley and yet one additional site (Spotted Lake) was added. The Prairie Population is currently small (estimated 1800 – 3500 at seven sites, but there are many more sites) but larger than the 1000 individuals estimated in 2002. This can be inferred from the additional 126 sites recorded since 2002, bringing the total to 132 known occupied sites. Habitat mapping in SK grouped known sites into 111 habitat polygons using a 222m radius around the outermost occurrence within a grouping.

Threats and Limiting Factors

The primary threat to the Southern Mountain Population is habitat degradation and loss, which has resulted in the loss of at least one site within the past decade. Right-of-way maintenance disrupts roadside sites in the Similkameen Valley, and gravel extraction could affect the largest known site in Keremeos. Conversely, minor disturbance may benefit host plants by maintaining the early successional habitat required for these plants.

Most Prairie Population sites are protected within Grasslands National Park and have no primary threats. However, the divestment of federal community pastures to the province of SK may result in the sale of these lands to private individuals or private business consortiums. Non-native weeds can be significant competitors of host plants at some sites, potentially reducing larval food supply.

The distribution of the larval host plants limits the areas of potential habitat for Mormon Metalmark in both the Southern Mountain and Prairie DUs, but both buckwheat species occur in many areas where the butterfly is currently absent. Both Canadian populations are at the northern limits of the species' range so microclimate and related site variables (e.g., slope, aspect) may be limiting factors.

Protection, Status, and Ranks

Under the federal *Species at Risk Act* the Southern Mountain Population is listed as Endangered and the Prairie Population as Threatened. The subnational conservation status rank in both BC and SK is critically imperilled (S2); and the global conservation status rank is secure (S5). The species is ranked as At Risk (1) by the General Status program, both in Canada and in BC, and as Sensitive (3) in SK. None of the Southern Mountain Population sites are within protected areas. Approximately 92% of Prairie Population sites are within Grasslands National Park and federal community pastures. Divesture of community pastures by Agriculture Canada to the province of SK will proceed in the next few years, which will potentially affect Mormon Metalmark populations if there is a change in land use practices.

TECHNICAL SUMMARY - DU1 Southern Mountain Population

Apodemia mormo
Mormon Metalmark
Southern Mountain population

Mormon
Population des montagnes du Sud

Range of occurrence in Canada: British Columbia

Demographic Information

Generation time	1 year to complete life cycle
Is there an [observed, inferred, or projected] continuing decline in number of mature individuals?	Yes, observed and inferred; based on habitat loss and degradation
Estimated percent of continuing decline in total number of mature individuals within [5 years or 2 generations]	Unknown
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over the last [10 years, or 3 generations].	Unknown
[Projected or suspected] percent [reduction or increase] in total number of mature individuals over the next [10 years, or 3 generations].	Unknown
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over any [10 years, or 3 generations] period, over a time period including both the past and the future.	Unknown
Are the causes of the decline clearly reversible and understood and ceased?	Causes of decline are partially understood; not reversible and not ceased.
Are there extreme fluctuations in number of mature individuals?	No.

Extent and Occupancy Information

Estimated extent of occurrence	358 km²
Index of area of occupancy (IAO)	88 km²
Is the population severely fragmented?	No. Each site is within a few km of the others and adults likely move between sites.
Number of locations*	4 – 5
Is there an [observed, inferred, or projected] continuing decline in extent of occurrence?	No. The extent of occurrence has increased since the initial COSEWIC (2003) status report. There is a new site in the Okanagan Valley. However, there is a decline in the patch size and quality of known sites.

*See Definitions and Abbreviations on the COSEWIC website and IUCN 2010 for more information on this term.

Is there an [observed, inferred, or projected] continuing decline in index of area of occupancy?	Yes. The number of known sites has increased since the initial COSEWIC (2003) status report. However, there is a decline in the patch size and quality of known sites.
Is there an [observed, inferred, or projected] continuing decline in number of populations?	No.
Is there an [observed, inferred, or projected] continuing decline in number of locations*?	No.
Is there an [observed, inferred, or projected] continuing decline in [area, extent and/or quality] of habitat?	Yes. Based on habitat degradation and loss at known sites.
Are there extreme fluctuations in number of populations?	No
Are there extreme fluctuations in number of locations*?	No
Are there extreme fluctuations in extent of occurrence?	No
Are there extreme fluctuations in index of area of occupancy?	No

Number of Mature Individuals (in each population)

Population	N Mature Individuals
Southern Mountain	Unknown. Estimated 3000 minimum.
Total	Unknown. Estimated 3000 minimum.

Quantitative Analysis

Probability of extinction in the wild is at least [20% within 20 years or 5 generations, or 10% within 100 years].	No information available.

Threats (actual or imminent, to populations or habitats)

Habitat loss and degradation at roadside sites, especially due to periodic road maintenance, natural succession at some sites and invasive non-native plants at some sites. Most sites are on private land and without best practices or stewardship agreements with the landowners.

Rescue Effect (immigration from outside Canada)

Status of outside population(s)?	Unknown. Likely stable.
Is immigration known or possible?	Immigration unknown; BC sites are at least 22 km from WA sites.
Would immigrants be adapted to survive in Canada?	Yes, based on genetic similarity between WA and BC specimens.
Is there sufficient habitat for immigrants in Canada?	Possibly.
Is rescue from outside populations likely?	Unknown. Butterfly has low detectability at sites, occurs in low populations and has limited dispersal.

*See Definitions and Abbreviations on the COSEWIC website and IUCN 2010 for more information on this term.

Data-Sensitive Species

Is this a data-sensitive species?	Yes. Most BC sites are already in the public domain. Some sites on roadways adjacent to First Nations' land are data-sensitive.

Status History

COSEWIC: Designated Endangered in May 2003. Status re-examined and confirmed in May 2014.

Status and Reasons for Designation:

Status:	**Alpha-numeric code:**
Endangered	C2a(i)
Reasons for designation: This butterfly is found in very small numbers within small habitat patches in the narrow valley bottoms of the Similkameen and Okanagan valleys of southern British Columbia. The valley bottoms are also an important transportation and utility corridor, and the butterfly is threatened by road maintenance and other land development activities, as well as the growth of invasive plants that shade out their host plants.	

Applicability of Criteria

Criterion A (Decline in Total Number of Mature Individuals): Not applicable. Rates of decline unknown.
Criterion B (Small Distribution Range and Decline or Fluctuation): Not applicable since it is unclear whether the population is severely fragmented, and the number of locations may exceed 10.
Criterion C (Small and Declining Number of Mature Individuals): Meets Endangered C2a(i) since there are fewer than 2500 mature individuals (estimated 1,800), there is an inferred continuing population decline based on habitat loss, and no subpopulation is estimated to contain more than 250 mature individuals.
Criterion D (Very Small or Restricted Population): Not applicable. Exceeds threshold.
Criterion E (Quantitative Analysis): None completed.

TECHNICAL SUMMARY - DU2 Prairie Population

Apodemia mormo
Mormon Metalmark
Prairie population

Mormon
Population des Prairies

Range of occurrence in Canada: Saskatchewan

Demographic Information

Generation time	1 year to complete life cycle
Is there an [observed, inferred, or projected] continuing decline in number of mature individuals?	Unknown
Estimated percent of continuing decline in total number of mature individuals within [5 years or 2 generations]	Unknown
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over the last [10 years, or 3 generations].	Unknown
[Projected or suspected] percent [reduction or increase] in total number of mature individuals over the next [10 years, or 3 generations].	Unknown
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over any [10 years, or 3 generations] period, over a time period including both the past and the future.	Unknown
Are the causes of the decline clearly reversible and understood and ceased?	Unknown
Are there extreme fluctuations in number of mature individuals?	No.

Extent and Occupancy Information

Estimated extent of occurrence	1891 km²
Index of area of occupancy (IAO) (Always report 2x2 grid value).	376 km²
Is the population severely fragmented?	No
Number of locations*	> 10
Is there an [observed, inferred, or projected] continuing decline in extent of occurrence?	No. The number of known sites has increased in the past ten years due to increased survey effort.
Is there an [observed, inferred, or projected] continuing decline in index of area of occupancy?	No
Is there an [observed, inferred, or projected] continuing decline in number of populations?	No
Is there an [observed, inferred, or projected] continuing decline in number of locations*?	No

*See Definitions and Abbreviations on the COSEWIC website and IUCN 2010 for more information on this term.

Is there an [observed, inferred, or projected] continuing decline in [area, extent and/or quality] of habitat?	Yes, based on increasing abundance of invasive plants.
Are there extreme fluctuations in number of populations? • < 2000 in 2002 at 6 known sites • 1800 – 3500 in 2012 at 7 sites, 126 sites recorded since 2002 bringing the total to 132 known occupied sites.	No
Are there extreme fluctuations in number of locations*?	No
Are there extreme fluctuations in extent of occurrence?	No
Are there extreme fluctuations in index of area of occupancy?	No

Number of Mature Individuals (in each population)

Population	N Mature Individuals
Prairie	Estimated 1800 - 3500 minimum; but this is based on 7 sites. The population is likely greater than this estimate.
Total	Estimated 1800 - 3500 minimum but this is based on 7 sites. The population is likely greater than this estimate.

Quantitative Analysis

Probability of extinction in the wild is at least [20% within 20 years or 5 generations, or 10% within 100 years].	None available.

Threats (actual or imminent, to populations or habitats)

Habitat Loss and Degradation

Rescue Effect (immigration from outside Canada)

Status of outside population(s)?	Likely stable.
Is immigration known or possible?	Possible but unlikely
Would immigrants be adapted to survive in Canada?	Possibly
Is there sufficient habitat for immigrants in Canada?	Possibly
Is rescue from outside populations likely? • Very limited dispersal ability and disjunct populations	Possible

Data-Sensitive Species

Is this a data-sensitive species?	No

* See Definitions and Abbreviations on the COSEWIC website and IUCN 2010 for more information on this term.

Status History

COSEWIC: Designated Threatened in May 2003. Status re-examined and designated Special Concern in May 2014.

Status and Reasons for Designation:

Status:	**Alpha-numeric code:**
Special Concern	Not applicable
Reasons for designation: This butterfly occurs in the remote badlands and grassland habitats of Grasslands National Park and adjacent community pastures. Because of extensive surveys in the last decade, the known population of this butterfly is now large enough that it no longer meets the criteria for Threatened. There are few direct threats to the butterfly, although the slow spread of non-native plants that may compete with host plants and overgrazing in areas outside of the park are of concern and may impact habitat quality.	

Applicability of Criteria

Criterion A (Decline in Total Number of Mature Individuals): Not applicable. Rates of decline unknown.
Criterion B (Small Distribution Range and Decline or Fluctuation): Not applicable. Nearly meets Threatened since the EO is less than 20,000km² (1,891km²), the IAO is less than 2,000 km² (376km²); however, none of the other sub-criteria are met and the threat of invasive plants is not imminent (greater than 10 years).
Criterion C (Small and Declining Number of Mature Individuals): Not applicable. Declines unknown.
Criterion D (Very Small or Restricted Population): Not applicable. Exceeds threshold.
Criterion E (Quantitative Analysis): None available.

PREFACE

Mormon Metalmark has two designatable units in Canada: the Southern Mountain Population occurs in south central British Columbia and the Prairie Population occurs in southwestern Saskatchewan. In 2003 the species was assessed by COSEWIC: the Southern Mountain Population was assessed Endangered and the Prairie Population Threatened.

Since the initial status report, there has been substantial search effort and information gathered in both BC and SK. In BC, eight additional sites have been recorded including one site in the species' historic range in the Okanagan Valley. Surveys in Saskatchewan have recorded an additional 126 sites within Grasslands National Park and adjacent federal community pastures. Sites are defined as contiguous habitat patches of variable sizes that contain a population of Mormon Metalmark, although migration between habitat patches is unknown. Recent genetic work supports the Canadian populations as two separate designatable units.

COSEWIC HISTORY

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list. On June 5, 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal entities (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biodiversity Information Partnership, chaired by the Canadian Museum of Nature), three non-government science members and the co-chairs of the species specialist subcommittees and the Aboriginal Traditional Knowledge subcommittee. The Committee meets to consider status reports on candidate species.

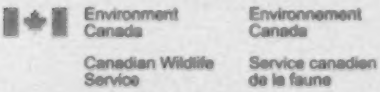
DEFINITIONS (2014)

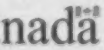
Wildlife Species	A species, subspecies, variety, or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and is either native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years.
Extinct (X)	A wildlife species that no longer exists.
Extirpated (XT)	A wildlife species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A wildlife species facing imminent extirpation or extinction.
Threatened (T)	A wildlife species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.
Not at Risk (NAR)**	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
Data Deficient (DD)***	A category that applies when the available information is insufficient (a) to resolve a species' eligibility for assessment or (b) to permit an assessment of the species' risk of extinction.

* Formerly described as "Vulnerable" from 1990 to 1999, or "Rare" prior to 1990.

** Formerly described as "Not In Any Category", or "No Designation Required."

*** Formerly described as "Indeterminate" from 1994 to 1999 or "ISIBD" (insufficient scientific information on which to base a designation) prior to 1994. Definition of the (DD) category revised in 2006.





The Canadian Wildlife Service, Environment Canada, provides full administrative and financial support to the COSEWIC Secretariat.

COSEWIC Status Report

on the

Mormon Metalmark

Apodemia mormo

Southern Mountain population
Prairie population

in Canada

2014

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WILDLIFE SPECIES DESCRIPTION AND SIGNIFICANCE

Name and Classification

Species classification:

Phylum	Arthropoda - arthropods
Class	Insecta – insects
Subclass	Pterygota – winged insects
Order	Lepidoptera – butterflies, moths
Superfamily	Papilionoidea – butterflies Latreille 1802
Family	Riodinidae Grote 1895 - Metalmarks
Subfamily	Riodininae Stichel 1911
Genus	*Apodemia* C. Felder and R. Felder 1865
Species	*A. Mormo* (C. Felder and R. Felder 1859)

English common name: Mormon Metalmark

French common name: Le Mormon

Type locality: "Mormonenlande", Utah, and named the species *mormo* based on this knowledge (Pyle 2002). The common name refers to the shiny metallic spots or streaks found on many members of this Riodinidae, although not Mormon Metalmark.

Mormon Metalmark, *Apodemia mormo,* (C. Felder and R. Felder 1859) is the only species of the metalmark family Riodinidae in Canada (Layberry *et al.* 1998). Metalmarks are closely related to the brush-footed butterflies (Lycaenidae), and are treated as a subfamily (Riodininae) by some authors (e.g., Wagner 2005). *Apodemia* is a Nearctic genus of 12 species (Pelham 2012) mainly found in the southwestern United States (US) and northern Mexico.

Mormon Metalmark taxonomy is poorly understood. *Apodemia mormo sensu lato* currently includes twenty named subspecies (Scott 1986a; Emmel and Emmel 1998; Emmel *et al.* 1998ab). Several authors suggest this complex includes multiple species-level taxa; however, there is no consensus on species-level geographic boundaries (Pelham 2012). Opler (1999) divides *Apodemia mormo* into four subspecies while Pelham (2012) recognizes seven.

The Canadian populations have been assigned to the nominate subspecies *Apodemia mormo mormo* (C. Felder and R. Felder 1859) (Layberry *et al.* 1998; Opler 1999) although there is some debate regarding BC and SK populations being separate subspecies. British Columbia (BC) populations are treated as *A. m. mormo* (Guppy and Shepard 2001; Pyle 2002; James and Nunnallee 2011). Scott (1986a) considered the Saskatchewan (SK) population to be *A. m. mejicanus* Behr. In a more recent paper, Scott and Fisher (1998) identified a subspecies from south-central Colorado east of the continental divide as *A. m. pueblo* Scott, but did not reassess the SK population. *A. m. pueblo* superficially resembles those Mormon Metalmarks from BC (COSEWIC 2002).

Until there has been a detailed comparison of the disjunct Canadian populations with those in regions further south, it seems premature for the purposes of this assessment, to assign them to a described subspecies (COSEWIC 2002). Recent mtDNA analysis (see Designatable Units), however, confirms that the two Canadian populations should be treated as distinct units (Proshek *et al.* 2013).

Morphological Description

Mormon Metalmark has four life stages: adult, larvae, pupa and egg. Mormon Metalmark adults have a small wingspan (25 to 32 mm) (Layberry *et al.* 1998; Scott 1986a) (Figure 1, Figure 2). In Canadian populations, the base colour on the upper wings is brown with many white spots and black marks. The central part of the forewing is orange on both the upper and lower surfaces. The underside is otherwise grey with white spots. The body is grey with white markings along the sides and between abdominal segments, the eyes are green, and the relatively long antennae have alternating black and white rings. Males and females are sexually dimorphic: females are larger and have three pairs of functioning legs, whereas the smaller males have forelegs that lack tarsal segments and are not used for walking (Guppy and Shepard 2001). The Prairie Population (SK) individuals have a small amount of orange on their dorsal hind wings but lack the extensive orange markings on the hindwing that are characteristic of *A. m. mejicanus*, which ranges further south.

Figure 1. Southern Mountain Population Mormon Metalmark. Dorsal (left) and ventral (right) views of males collected from Keremeos, British Columbia. Photograph by Norbert Kondla.

Figure 2. Dorsal view of Prairie Population Mormon Metalmark, Grasslands National Park, Saskatchewan. Photo by Shelley Pruss.

Most information on the immature life stages of Mormon Metalmark in Canada are from observations of the Prairie Population. Larvae from the Prairie Population are up to 25 mm long and have "a purple body, with two dorsal and two ventral rows of yellow nodules from which protrude a clump of bristly black hairs and a single longer white hair" (Figure 3; Peterson *et al.* 2010). The eyes and mouthparts are black and bulbous. The three pairs of true, thoracic legs are thick, black, and pointed, whereas the five pairs of abdominal prolegs are pink, rounded, and fleshy (Peterson *et al.* 2010). Mormon Metalmark larvae are similar to those of the closely related brush-footed butterflies (Lycaenidae) but cannot retract the head and the spiracle on the first abdominal segment is displaced anteroventrally (Ballmer and Pratt 1989).

Figure 3. Mormon Metalmark caterpillar from Saskatchewan (Prairie Population) on larval host plant, Few-flowered Buckwheat. Photo by Shelley Pruss.

The pupa is mottled light to dark brown and partly hairy (Scott 1986a; Pyle 2002; James and Nunnalle 2011) (Figure 4). Eggs from the Prairie Population are amber-coloured and the approximate size of a pinhead (Wick *et al.* 2012). Elsewhere in its range, eggs are flattened spheres, pink turning purple, honeycombed all over the surface, with short spikes protruding from the corners of the pentangles, and with a distinct micropyle (Scott 1986a; Pyle 2002; James and Nunnalle 2011).

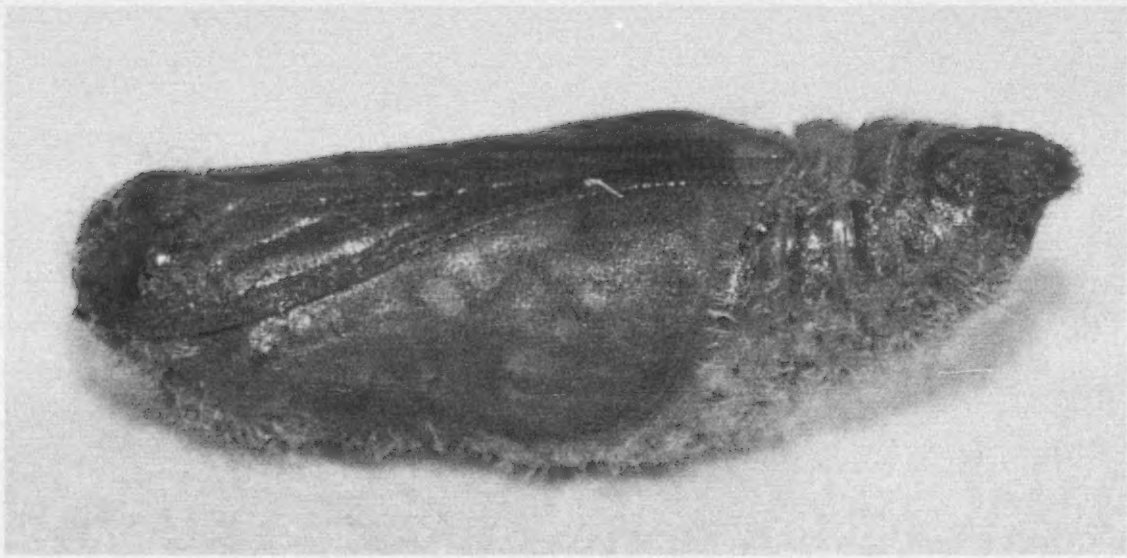

Figure 4. Mormon Metalmark pupa from Utah. Photo by N. Davis photo.

Eggs and larvae of the Southern Mountain Population have not been described but are likely similar to the Prairie Population.

Population Spatial Structure and Variability

Using amplified fragment length polymorphism (AFLPs), low overall genetic diversity and high levels of spatial genetic structure were found within Mormon Metalmarks in BC, suggesting that many subpopulations may be experiencing low levels of gene flow or high genetic drift (Crawford *et al.* 2011). Similarly, in a study using mtDNA and microsatellites, Mormon Metalmarks from Keremeos, BC, were found to be genetically depauperate. They were found to be closely related to those in adjacent northern Washington (e.g., Toats Coulée, Shanker's Bend), but no recent genetic connection was found to other sampled populations in the Pacific Northwest (Proshek *et al.* 2013).

In contrast, Mormon Metalmarks in SK were found to be genetically diverse with evidence of gene flow between them and a number of sampled populations from Montana and other neighbouring U.S. states. Population structure within SK was not detected, but Mormon Metalmarks from the East Block of Grasslands National Park were less diverse than comparable samples from other populations in the West Block or neighbouring U.S. states (Proshek *et al.* 2013).

The Rocky Mountains are inferred as being a significant barrier to gene flow between metalmark populations in Canada, and genetic data show that populations in BC and SK are not closely related (see next section).

Designatable Units

Mormon Metalmark has two designatable units in Canada. The BC population is within the Southern Mountain Ecological Area and termed the Southern Mountain Population while the SK population is in the Prairie Ecological Area and termed the Prairie Population (COSEWIC 2010).

Recent genetic work has confirmed the validity of treating these populations as separate designatable units (Proshek *et al.* 2013). Using mtDNA, populations from BC and SK were found to exhibit over 3% sequence divergence at the cytochrome oxidase I gene. Using four microsatellite loci, pairwise genetic divergence between populations was estimated using D_{EST}, a statistic analogous to F_{ST}. D_{EST} was found to be 0.84 between the BC and SK populations. Both results indicate that populations from the two provinces are not closely related. In addition, the BC and SK populations use different larval host plants (see Canadian Range).

Special Significance

Mormon Metalmark is emblematic of a southern biogeographic element that reaches its northern limit in extreme southern BC and southwestern SK. The Antelope-Brush (*Purshia tridentata*) ecosystem of the arid south Okanagan and Similkameen valleys is one of the four most endangered ecosystems in Canada (Schluter *et al.* 1995) and the area supports approximately 15,000 invertebrate species, including provincially, nationally, and globally rare taxa (Cannings and Cannings 1995; Heron 2004). The south Okanagan Valley and lower Similkameen Valley are considered the second most important hot spot for butterfly conservation in BC and AB (Kondla *et al.* 2000).

The ecological role of Mormon Metalmark has not been researched, but is an important component of the conservation value of BC's native ecosystems. Mormon Metalmark's relationship to its host plant is of significance to local First Nations (Armstrong 2012).

DISTRIBUTION

Global Range

Mormon Metalmark *sensu lato* ranges through the western United States from northern Mexico to extreme southern BC and southwestern SK (Figure 5). The core of the species' range is in California, Nevada, Arizona, Utah, Colorado and New Mexico although the species is recorded from 13 states (Opler *et al.* 2012). Using the inclusive taxonomic concept of *Apodemia mormo*, the species ranges as far south as the Mexican state of Sinaloa (*A. m. mejicanus* Behr) and Baja California (*A. m. virguleti* Behr), and extends eastward into Texas (*A. m. duryi* W. H. Edwards). Opler (1999) and Pelham (2012) consider the Mexican subspecies to be a completely separate species.

Figure 5. Known North American range of Mormon Metalmark, *Apodemia mormo* (COSEWIC 2002). Populations in regions shown in grey have been split from *Apodemia mormo* by Opler 1999.

Mormon Metalmark reaches the northern extent of its range in BC and SK. In the west, the species occurs in a series of disjunct populations along the Columbia and Missouri valleys and tributaries (Scott 1986a; Opler *et al.* 2012) and its range extends from northern Washington (WA) into BC along the Similkameen River. The populations in WA are thought to be the same subspecies as those in BC (Pyle 2002). In the eastern part of its range, the species occurs along the Milk and Missouri Rivers and tributaries in North Dakota, Montana and north into SK. This population is spatially separate from the main range of metalmarks in the southwestern U.S. (Opler 1999) with unclear taxonomy.

Canadian Range

The Canadian range includes two small, disjunct populations: Southern Mountain Population in south-central BC (Figure 6) and Prairie Population in southwestern SK (Figure 7). There has been a small increase in the known range of both populations since the initial COSEWIC (2002) status report. Canada has less than 1% of the global range and population (Cannings *et al.* 1998) and represents the northern limit of its continental range (Layberry *et al.* 1998; Guppy and Shepard 2001; Opler *et al.* 2012).

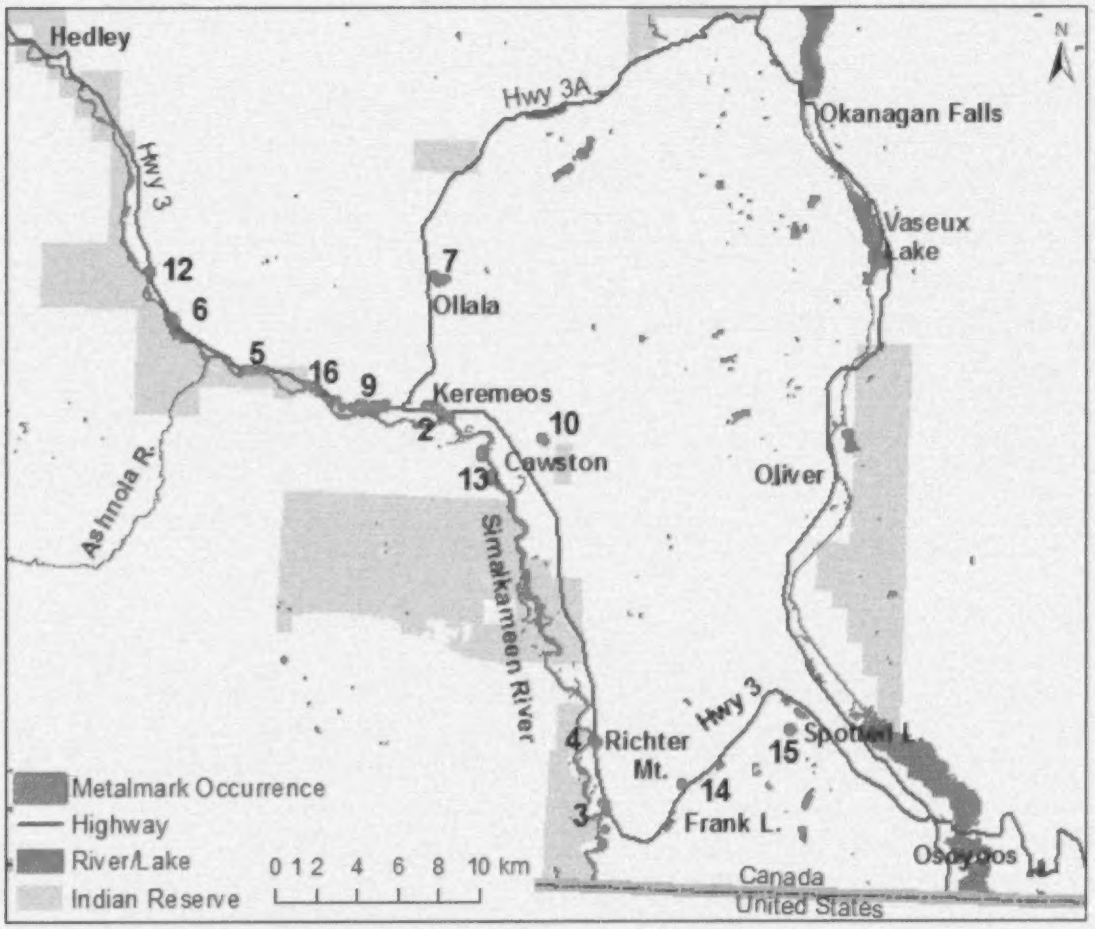

Figure 6. Known range of Mormon Metalmark Southern Mountain Population (modified from Southern Interior Invertebrates Recovery Team 2008)*. *site numbers refer to British Columbia Conservation Data Centre 2014 (2012) polygon occurrence numbers (see Table 1). Some sites have multipart polygons. Site numbers #1 and #8 are confidential and do not appear on the map. The site recorded from Vaseaux Lake in 1929 is vague and not plotted on the map.

Southern Mountain Population:

Mormon Metalmark occurs along the lower Similkameen Valley. Records occur within and around the town of Keremeos, north of Keremeos approximately 6 km, from near Olalla, and approximately 15 km west to [near] Paul (Shoemaker) Creek. There is a historic record (1929) from the Okanagan valley near Oliver and Okanagan Falls (Vaseux Lake) (Layberry *et al.* 1998). In 2009 the species was recorded in the Okanagan Valley northwest of Osoyoos and 10km south of Oliver near Spotted Lake (confirmed in 2012) (British Columbia Conservation Data Centre 2014).

As of 2012, 13-15 extant sites are known from the Similkameen and Okanagan valleys (Figure 6, Table 1). A site is defined as a contiguous patch of suitable, occupied habitat, and in most cases sites are extremely small (< 1ha). In 2002, there were 14 "colonies" in BC belonging to six populations (referred to as "sites" in this report (COSEWIC 2002)). Between 2003 and 2012, additional sites included several small sites near Richter Mountain, one north of Paul Creek, and two new sites on the southwest bank of the Similkameen River west of Cawston, two sites on Highway 3 east of the Similkameen Valley (Frank Lake) and in the Okanagan (Spotted Lake). Additional sites likely occur on unsurveyed First Nations' lands in the Similkameen Valley. Based on updated 2012 mapping (British Columbia Conservation Data Centre 2014), these sites encompass approximately 52 ha of habitat, although the butterfly is not evenly distributed throughout this habitat.

Table 1. Mormon Metalmark records in British Columbia showing maximum daily number of adults counted during surveys (BC Conservation Data Centre 2012). See Figure 6 for map of occurrences.

Site #[1]	Site Name(s)	1990	1991	1995	1998	2001	2002	2003	2004	2005	2006	2007	2008	2009	2012	CDC Mapped Area (ha)
1	Confidential site															
2a	Keremeos (Argo gravel pit; S slope)[C1]							7	4	3	222	10	15		12	3.3
2b	Keremeos (end of 8th Ave.)[C2]	100	2	350	200	51	10	15	16	8	45	7	27			3.5
3a	SW of Richter Mountain #1 (Chopaka S)			2												1.7
3b	SW of Richter Mountain #2									2	1					0.8
3c	SW of Richter Mountain #3									4	1					0.2
3d	SW of Richter Mountain #4									12	2					0.3
4	W of Richter Mountain (Chopaka N)			1												2.8
5a	Similkameen River, "Goat View" #1 West [W2]			1				2	2	11	107	18	17		1	1.4
5b	Similkameen River, "Goat View" #2 North							1					1			0.8
6	Keremeos, Suncatchers RV [W1]							3	2	4	24	2	12			1.8
7	Olalla [N1,N2]					2			2	9	9	17	16	20		5.8
9a	N of Bullock Creek, #1									9						0.6

Site #[1]	Site Name(s)	1990	1991	1995	1998	2001	2002	2003	2004	2005	2006	2007	2008	2009	2012	CDC Mapped Area (ha)
9b	N of Bullock Creek, #2															0.1
9c	N of Bullock Creek, #3 [W5]							11	52		73				2	8.3
9d	N of Bullock Creek, #4 (BNR-W; Red Bridge)[W6]					5	2	22	54	87	72	22	55	9		2.3
9e	N of Bullock Creek, #5							30		2		7	10			0.2
9f	N of Bullock Creek, #6 [W7]								9		11					1.1
9g	N of Bullock Creek, #7															0.0
9h	N of Bullock Creek, #8 [W8]							30	7		62					3.8
10	Keremeos, Gravel Pit (Shaw Dr.; Blind Cr.)					4	7	2	2	1	12				1	1.3
12	1.3 km north of Paul Creek,									2	2				2	0.5
13a	1.5 km W of Cawston #1 (N, large)[E1]											13	20			4.7
13b	1.5 km W of Cawston #2 (S, small)[E2]											10	11			1.7
14	1.5 km N of Frank Lake													1	3	0.4
15	Spotted Lake													11	3	1.6
16[4]	Riverside Estates (Desjardins)[W3, W4]			35			1	31	46		28				3	3.8
	TOTAL	**100**	**2**	**389**	**200**	**62**	**20**	**154**	**196**	**154**	**671**	**106**	**184**	**41**	**27**	**52.6**

[1] BC Conservation Data Centre (2012) element occurrence (EO) number (note: there are missing numbers); letters have been added to differentiate separate polygons within the same EO

[2] BC CDC (2012) occurrence polygon name; alternate names commonly used by other authors in unpublished reports are in ( ); "subpopulation" names used by Crawford *et al.* 2011 are in [ ]

[3] mapped CDC polygon area with some boundary revisions based on 2012 fieldwork (note: entire polygon may not be occupied in all years)

[4] this site is not numbered by the British Columbia Conservation Data Centre (2012) but is labelled here and in Figure 6 as #16.

The species' potential range is restricted to that of its larval host plant, Snow Buckwheat (*Eriogonum niveum*) (see Habitat). Snow Buckwheat is restricted to the lower Similkameen and Okanagan valleys as far north as Vernon (Klinkenberg 2012b). Mormon Metalmarks occupy a small portion of the range of Snow Buckwheat suggesting other factors influence distribution.

Prairie Population:

In 2002, six sites were known within Grasslands National Park: one in the Killdeer Badlands (Rocky Creek) of the East Block, and five in the West Block of which two are within the current Grasslands National Park (GNP) boundary and three are in adjacent Val Marie Community Pasture within the proposed boundary to the south (Hooper 2002).

Twelve new sites were found in the West Block during 2006-2007 surveys and additional new potential sites were found in the East Block in 2008 (Henderson 2008). Wick (2013) increased the number of known sites from 37 to 88 during three weeks of targeted surveys in 2012. Surveys in 2013 have increased the known total to 132 sites (Figure 7) (Pruss. pers. comm. 2014). Habitat mapping in SK grouped the 132 known sites into 111 habitat polygons, using a 222m radius around the outermost occurrence within a site grouping (Pruss, Wick and Illerbrun unpubl. data 2013).

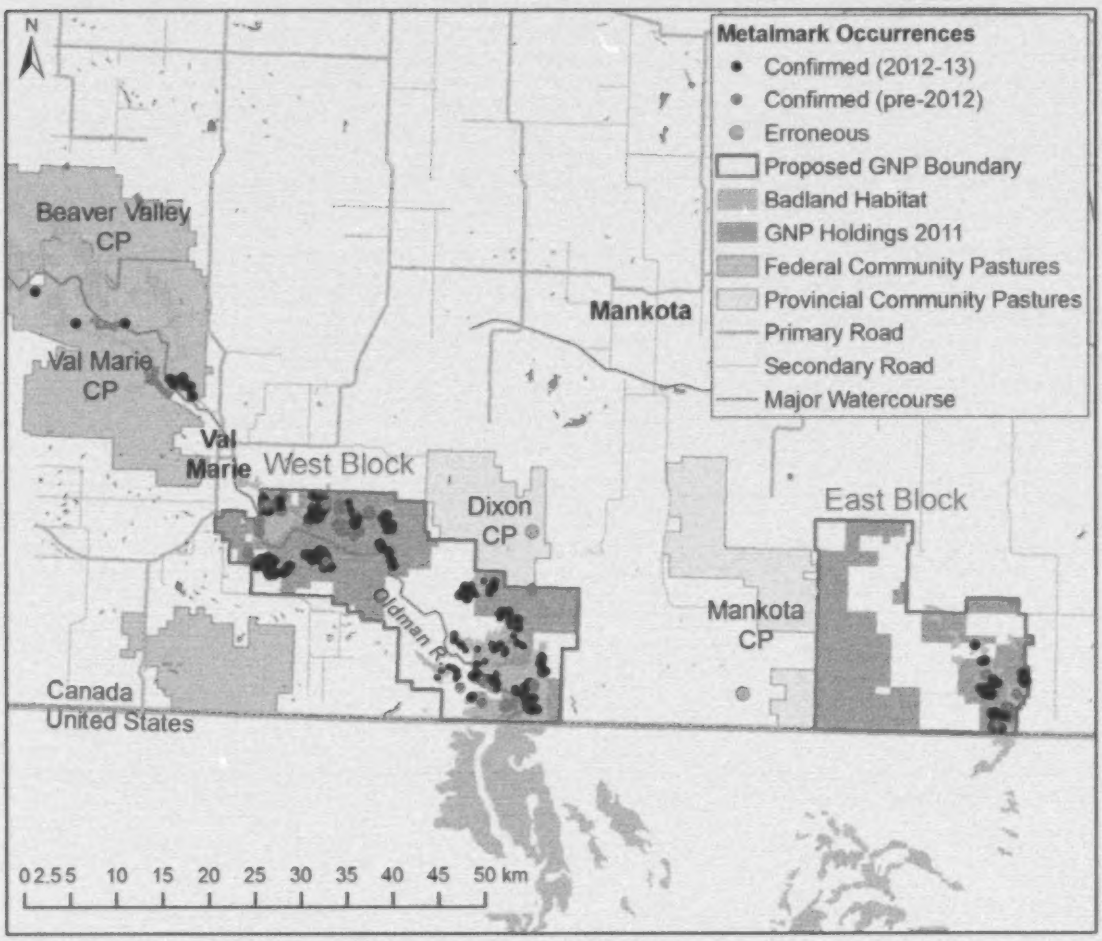

Figure 7. Known range of Mormon Metalmark Prairie Population near Grasslands National Park (GNP)(SK CDC 2012; Wick 2013, unpublished data). The area has not been systematically searched and may contain undocumented sites.

Extent of Occurrence and Area of Occupancy

Southern Mountain Population:

The extent of occurrence (EO) is 358 km^2 using a minimum convex polygon encompassing all extant sites in 2012 (Figure 12), double the 180 km^2 EO known in 2002 (COSEWIC 2002). The index of area of occupancy (IAO) is 88 km^2 based on a fixed 2 x 2 km grid (Figure 13), double the 44 km^2 IAO from 2002.

Prairie Population:

The EO is 1891 km^2 for all extant sites in 2012 (Figure 14), which is the same as 2002. The IAO is 376 km^2 (Figure 15), which is approximately nine times larger than the 44 km^2 IAO from 2002.

Search Effort

Southern Mountain Population:

Mormon Metalmark records in BC are from 1929 (Oliver) to 2012 (numerous sites throughout the Similkameen Valley and one in the Okanagan Valley). During this time, there have been more than 3000 Mormon Metalmarks records (collection or sight records) tallied for the Southern Mountain Population (British Columbia Conservation Data Centre 2014).

Targeted search effort for Mormon Metalmark in the south Okanagan and Lower Similkameen valleys occurred in 1995, 1998, and most years from 1999 to 2009 (St. John 1995; COSEWIC 2002; Southern Interior Invertebrates Recovery Team 2008; British Columbia Conservation Data Centre 2014; Table 2). In addition, mark-recapture surveys were conducted in 2006, 2007 and 2008 yielding a total of 1641 observations (Desjardins pers. data 2014).

Table 2. Summary of documented Canadian surveys for Mormon Metalmark.

Province	Year	Approximate Survey Effort	Source
BC	1994	D. St. John surveys in Okanagan and Similkameen valleys, repeat visits for some sites	St. John (1995)
BC	1995	11 sites in Similkameen Valley; 10-20 minutes per site; previously occupied sites visited at least twice if initial visit found no metalmarks	COSEWIC (2002)
BC	1998	13 sites; same methodology	COSEWIC (2002)
BC	2001	13 sites; same methodology	COSEWIC (2002)
BC	2002	unknown # of sites, similar methodology assumed	British Columbia Conservation Data Centre 2014

Province	Year	Approximate Survey Effort	Source
BC	2003	at least 13 sites, similar methodology assumed	British Columbia Conservation Data Centre 2014
BC	2004	224 point locations known sites in Similkameen Valley surveyed by an unknown # of observers from Aug 11-Sept 1 (176 from Aug 11-13)	Dyer (2006a)
BC	2005	30 sites in Similkameen Valley surveyed by 2 observers from Aug 8-Sept 13; did at least 3 visits at each site if no metalmarks observed	Yelland and Noble (2005)
BC	2006	210 point locations in Similkameen Valley surveyed Aug 16-24 by unknown number of observers; mark-recapture study conducted by S. Desjardins and crew (1063 observations; results not fully analyzed or published)	Dyer (2006b) Desjardins pers. data 2014
BC	2007	some conducted by S. Desjardins, J. Heron, J. Hobbs (details unavailable) mark-recapture study conducted by S. Desjardins and crew (189 observations; results not fully analyzed or published)	British Columbia Conservation Data Centre 2014 Desjardins pers. data 2014
BC	2008	some conducted by S. Desjardins, O. Dyer (details unavailable) mark-recapture study conducted by S. Desjardins and crew (389 observations; results not fully analyzed or published)	British Columbia Conservation Data Centre 2014 Desjardins pers. data 2014
BC	2009	some conducted by K. Robbins, A. Skinner (9 observations)	British Columbia Conservation Data Centre 2014
BC	2012	6 person-days by R. Foster and M. Jones targeting known and potential sites in south Okanagan and Similkameen valleys	Foster pers. data; data included in this status report
Prairie Population			
SK	1974	August 8, 1974	Hooper (1975)
SK	1983	surveys by R. Hooper and K. Roney, August 11, 1983	Roney, Hooper (COSEWIC 2002, Appendix G)
SK	2002	Aug 12-14 and 22-28, Sept 2-5 and 10-14 by R. Hooper, J. Pepper, and others; located metalmarks at 6 sites; not observed at 20 other sites with host plant; from south of Dollard to east of Big Muddy Badland and north to Saint Victor	COSEWIC (2002, Appendix G)

Province	Year	Approximate Survey Effort	Source
SK	2004	surveys by R. Hooper and J. Pepper on private land within proposed park boundary, Aug 24-27	Saskatchewan Conservation Data Centre 2012
SK	2006	approx. 1 wk of survey in East Block of Grasslands NP, with park staff	Henderson (2008)
SK	2007	visual surveys of GNP East Block with 2 park staff observers, Aug 11-15	Henderson (2008)
SK	2008	visual surveys of GNP West Block with park staff and U of A students, Aug 11-19	Henderson (2008)
SK	2009	August surveys by Peterson and Pruss	Peterson *et al.* (2010)
SK	2010	surveys by K. Peterson, E. Amosa, S. Pruss. And N. Erbilgin in June-July in West Block of GNP	Peterson *et al.* (2010)
SK	2011	multiple surveys for MSc on habitat associations	Wick (2013)
SK	2012	multiple surveys for MSc on habitat associations	Wick (2013)
SK	2013	surveys by Illerbrun, Wick, Pruss and Tabacaru	Pruss (pers. comm. 2014)

During the preparation for this status report (in 2012) 6 person-days of field surveys over 36 sites recorded a total of 27 metalmarks over 8 sites in the lower Similkameen and Okanagan valleys (Foster pers. comm. 2014; Harris pers. comm. 2014). The greatest number of observations was at an active gravel pit in the town of Keremeos (12 individuals) (Foster pers. comm. 2014; Harris pers. comm. 2014). Additional occupied habitat likely exists but is not known due to incomplete knowledge of the species' distribution (Southern Interior Invertebrates Recovery Team 2008).

Formal surveys on First Nations' land have been limited and not all potentially suitable habitats on private land have been surveyed. For example, one Mormon Metalmark was recorded in 2003 approximately 1.2 km west of the known site in the Keremeos gravel pit, along the same gravel ridge. There are 3.6 ha of privately owned, potentially suitable habitat along this ridge that was not surveyed in 2012.

Genetic analyses suggest that there may be gene flow between metalmark sites near Olalla and Keremeos through undocumented suitable habitat along the base of the mountains (Crawford *et al.* 2011). Two new unconfirmed metalmark sites have been reported about 6 km north of Olalla (Southern Interior Invertebrates Recovery Team 2008), but could not be field-verified for this report (these sites are not included in population totals or range area).

Casual surveys have also been conducted in WA State south of Nighthawk (BC) along the Similkameen River.

Prairie Population:

The first Mormon Metalmark records in SK are from 1974 in what is now the East Block of Grasslands National Park (erroneously reported as the first sighting in Canada in Hooper 1975), and what is now the West Block in 1983. No surveys were conducted until 2002 when six sites in the East and West Blocks of GNP, in the Killdeer Badlands along Rock Creek, and along the slopes of the lower Frenchman River Valley were recorded (Hooper 2002). In 2006, two new sites in the West Block of GNP were recorded (Pruss *et al.* 2008). "Many hours" in 2006 were spent unsuccessfully searching patches of Few-flowered Buckwheat (*Eriogonum pauciflorum* Pursh) at 20 other sites, including those which lacked host plants.

Mormon Metalmark was surveyed in 2006-2007 (West Block of GNP) and 2008 (East Block of GNP) (Pruss 2008). In 2008, unsurveyed habitat in the East Block (256 km^2 and additional habitat in the Red Buttes area) and West Block (35 km^2) (Henderson 2008). Recent surveys by have greatly increased the number of sites in GNP and adjacent Val Marie and Beaver Valley community pastures (Wick 2013; Pruss pers. comm. 2014). There have been an additional 126 sites recorded since 2002 bringing the total to 132 known occupied sites (Wick 2013; Pruss pers. comm. 2014). There appear to still be large areas of habitat that have not yet been searched for the butterfly, or at least search effort (null sites) is not recorded. These areas include the East Block of GNP and areas outside the park and between the East and West Blocks.

Most recent habitat mapping for Mormon Metalmark was completed by Pruss, Wick and Illerbrun (unpublished data 2013). Point occurrences were grouped into colonies and a 222m radius was mapped around the points. This mapping exercise suggests there are 111 polygons containing Mormon Metalmark (polygon size varies) within the surveyed area with 98 of these polygons inside (in part or in whole) of Grasslands National Park. Final results are forthcoming in the critical habitat mapping being completed for the species' federal recovery strategy.

Mormon Metalmarks have not been reported from Alberta (Pohl *et al.* 2010), despite surveys of potential habitat (e.g., in the Blakiston Fan in Waterton Lakes National Park, and the Agriculture Canada Onefour Research Station near Manyberries) (Anweiler 2008). The known Canadian host plants have not been recorded from AB (FNA 2012b,c), and although Yellow Buckwheat (*Eriogonum flavum*) is found in AB and adjacent jurisdictions (FNA 2012a), its use by Mormon Metalmarks has never been documented (Scott 1986a,b). Metalmark populations in Montana appear to be associated with Few-flowered Wild Buckwheat except one site where it is apparently absent and the possible larval host plant could be Alpine Golden Wild Buckwheat (*E. flavum*) (Kohler pers. comm. 2013).

HABITAT

Habitat Requirements

Across its North American range, Mormon Metalmark is found in a range of habitats including desert, grassland, chaparral, shrubland, and open mixed or hardwood woodland. The butterfly ranges from below sea level to low altitude summits, typically in dry, open, sloping habitats where larval host plants of the genus *Eriogonum* are present (Scott 1986a). In Canada, Mormon Metalmarks are associated with dry, eroding slopes with sufficient densities of their larval host plants and preferred adult nectar sources.

Southern Mountain Population:

All known BC sites occur in the Bunchgrass Biogeoclimatic Zone (British Columbia Conservation Data Centre 2014). Mormon Metalmark habitat includes hillsides, eroding slopes, and embankments with sandy or gravelly soils and moderate to high densities of the larval host plant Snow Buckwheat (*Eriogonum niveum*) (COSEWIC 2003). Stinking Rabbitbrush (*Ericameria nauseosa*) is also used by adults, which feed on the nectar and perch on the plants. The distribution of Snow Buckwheat includes southern BC, west-central Idaho, northeastern Oregon and eastern Washington (FNA 2012a). Snow Buckwheat (in BC) grows on south-facing slopes with an average gradient of 25% at an elevation of 511 m (Klinkenberg 2012b; Parish *et al.* 1996). Sites with these characteristics are uncommon, and their landscape position relative to other occupied sites may be important for metapopulation dynamics and persistence (COSEWIC 2002; Southern Interior Invertebrates Recovery Team 2008).

The larval and nectar plants are widely distributed within the Similkameen and Okanagan valleys but only a few sites where they occur are occupied by Mormon Metalmarks. Some apparently suitable sites are not occupied suggesting an incomplete understanding of its habitat needs (Southern Interior Invertebrates Recovery Team 2008; Dyer pers. comm. 2012). In BC, metalmarks do not appear to use level sites, even where Snow Buckwheat and Stinking Rabbitbrush are abundant (e.g., Ashnola River drainage), perhaps due to the more hard-packed, relatively fine-grained soils or microclimatic variables at these sites (COSEWIC 2002; St John. 1996). In the US, it has been reported from arid flats (James and Nunnallee 2011), so the preference for sloping sites may be related to climatic factors at the northern limit of its range.

Most extant sites in BC have southerly aspect, but range from east- to west-facing slopes; there are no known BC sites with a northerly aspect. All BC Mormon Metalmark sites are at elevations below 520 m elevation (Southern Interior Invertebrates Recovery Team 2008) with the exception of the recently discovered site near Spotted Lake in the Okanagan Valley (680 m) and the Olalla site (660 m) (British Columbia Conservation Data Centre 2014). Most of the occupied sites at the time of the 2002 COSEWIC status report were on relatively steep slopes and embankments along road rights-of-way, with Brittle Prickly-Pear Cactus (*Opuntia fragilis*) and bunchgrasses as common associates (Figure 8). In 2004-2006, Mormon Metalmarks were also observed using atypical habitat near Bullock Creek on more stabilized, rockier slopes with lower densities of Snow Buckwheat and Stinking Rabbitbrush, but abundant sagebrush (*Artemesia* spp.) (Figure 9).

Figure 8. Mormon Metalmark habitat at the Keremeos gravel pit on August 30, 2012, looking northeast. Photograph by Robert Foster.

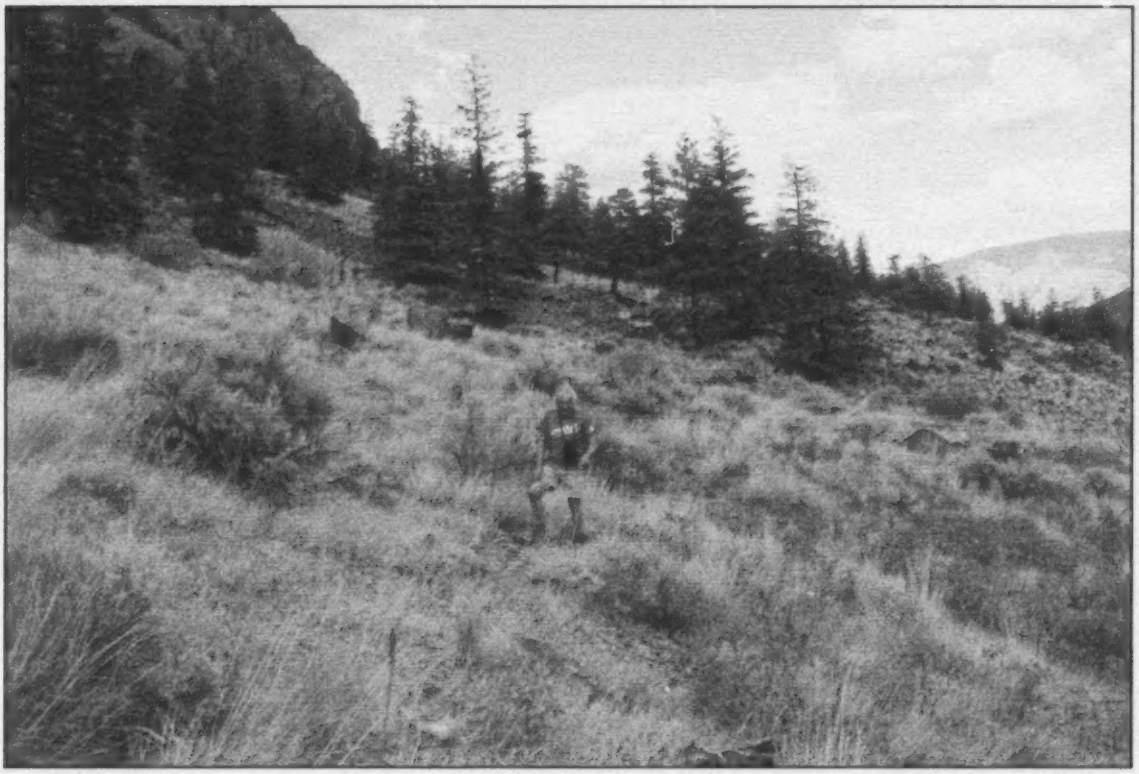

Figure 9. Gently sloping Mormon Metalmark habitat near Bullock Creek, BC, facing east on August 29, 2012. Photograph by Robert Foster.

Prairie Population:

Snow Buckwheat is not found east of the Rocky Mountains, and the larval host plant for Mormon Metalmarks in SK is Few-flowered Buckwheat (*Eriogonum pauciflorum* Pursh) (also known as Branched Umbrella-plant [*E. multiceps* Nees]) (COSEWIC 2002). Few-flowered Buckwheat is part of the Eroded Communities vegetation-landscape unit of GNP found where soils cannot develop because of constant erosion or because they are resistant to soil-building processes (Parks Canada 1994). In SK, metalmarks typically occur in association with their larval host plant on exposed, eroded hillsides, slopes, or embankments on barren clay or heavy clay soils as well as relatively level adjacent areas (Figure 10 and Figure 11) (Hooper 2002; Henderson 2008; Wick 2013; Pruss pers. comm. 2014). Few-flowered Buckwheat is common and widespread in many of SK's badland areas and there are roughly 290 km^2 within the current and proposed boundaries of Grasslands National Park, particularly the East Block where access is difficult (Pruss *et al.* 2008).

Figure 10. Mormon Metalmark habitat near 70 Mile Butte in the West Block of Grasslands National Park, May 9, 2009, facing southwest. Photograph by Shelley Pruss.

Figure 11. Close-up of Mormon Metalmark habitat near 70 Mile Butte in the West Block of Grasslands National Park, ca July 10, 2010, facing southeast. Photograph Parks Canada.

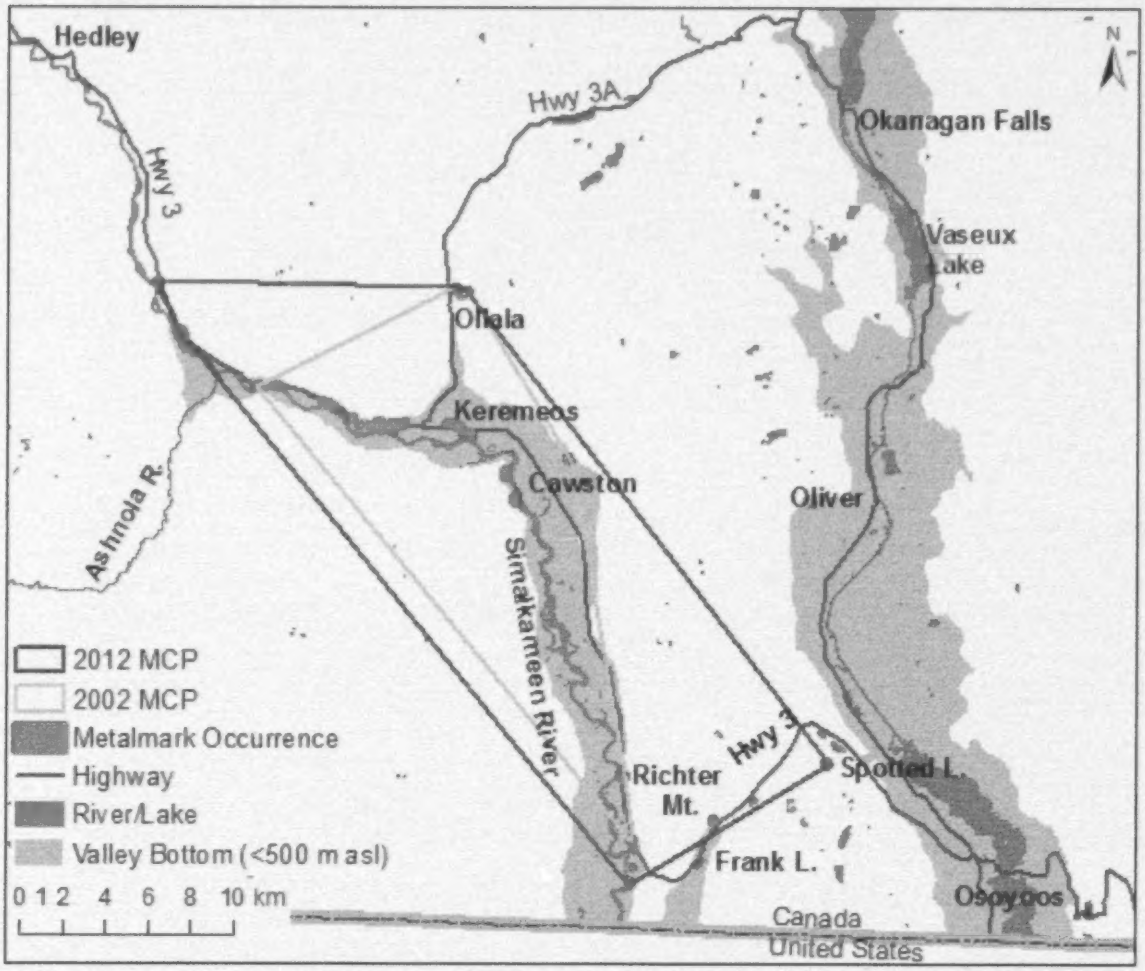

Figure 12. The extent of occurrence for the Southern Mountain Population of Mormon Metalmark in Canada using a minimum convex polygon is 358 km^2. Map created by Robert Foster.

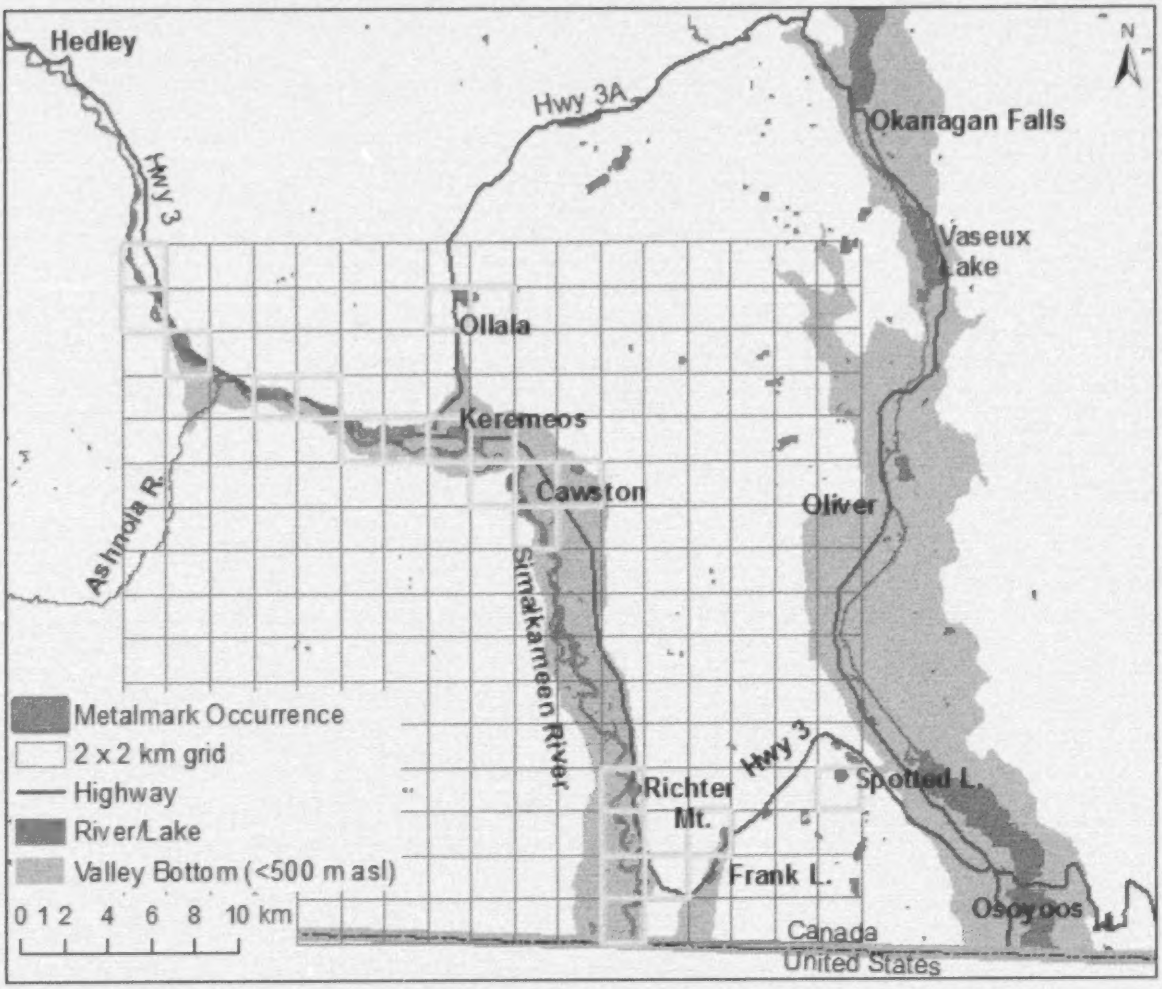

Figure 13. The index of area of occupancy for the Southern Mountain Population of Mormon Metalmark in Canada using a fixed 2 km x 2 km grid is 88 km^2. Map by Robert Foster.

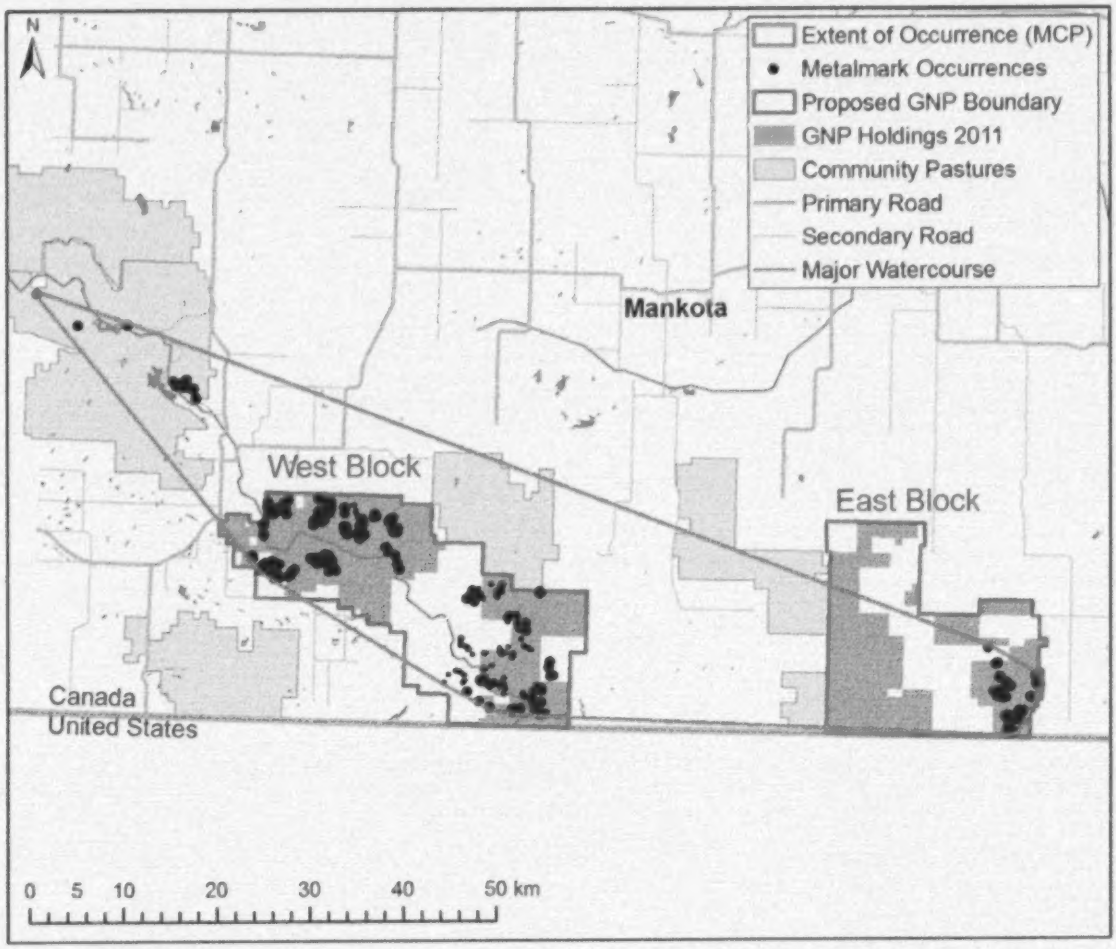

Figure 14. The extent of occurrence for the Prairie population of Mormon Metalmark in Canada using a minimum convex polygon is 1891 km^2. Map by Robert Foster.

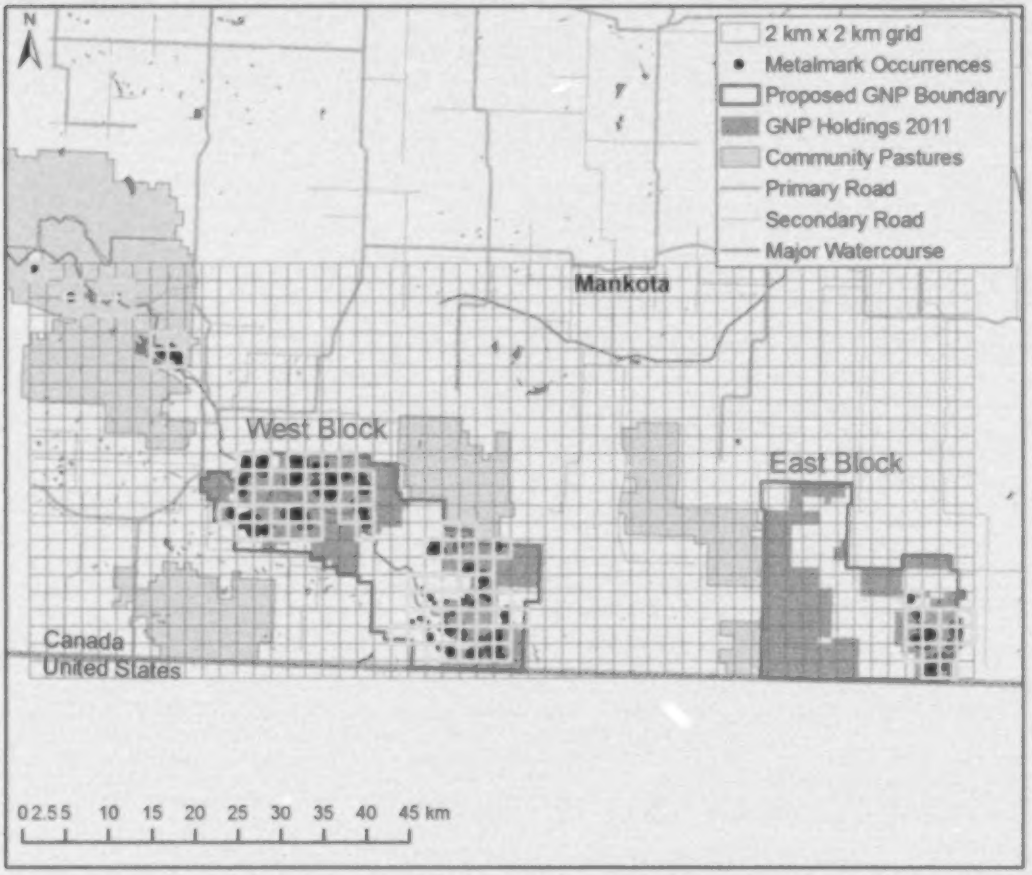

Figure 15. The index of area of occupancy for the Prairie population of Mormon Metalmark in Canada using a fixed 2 km x 2 km grid is 376 km^2. Map by Robert Foster.

In the East Block of GNP, metalmarks occupy long narrow patches of host plants in small, steep coulees and along the edges of creek beds in badlands habitat, whereas in the West Block they are found in large, expansive host plant patches (Henderson 2008). In the East Block all metalmark sightings were in soil associations with sandy loam, clay and loam elements with moderate to high erosion (Henderson 2008). As in BC, although apparently suitable habitats with larval host plants are more widely available, very few of these sites are occupied by metalmarks. The requirement for these habitat characteristics and details of differences between available but unoccupied and occupied habitat are not well understood and may therefore be limiting (Pruss *et al.* 2008). In contrast to BC, slope does not appear to be as important an attribute in habitat selection in SK (Henderson 2008).

Habitat Trends

Southern Mountain Population:

Habitat trends are difficult to determine given the recent documentation of new populations, loss of natural habitat and inconsistent delimitation and naming of occurrences.

Based on comparing the historic records (> 50 years before present) to present-day records, it appears that there has been greater than 50% reduction in extent of occurrence (Southern Interior Invertebrates Recovery Team 2008).

The amount of known habitat occupied has increased since the last status report (IAO 88km^2 in 2012 from 44km^2 in 2002) when approximately 15 ha of habitat was estimated to be occupied (COSEWIC 2002). The 2008 BC Recovery Strategy (Southern Interior Invertebrates Recovery Team 2008) reaffirmed this value, despite records of dozens of Mormon Metalmarks using what was previously considered unsuitable habitat near Bullock Creek.

There likely has been a long-term decline in natural habitat for Mormon Metalmark in BC, since it was formerly known as far north as the Okanagan Falls but now appears to be absent from most of the Okanagan Valley. Snow Buckwheat is common along roadcuts at low elevation only as far north as Summerland in the Okanagan Valley and fragmentation of suitable habitat may limit its distribution in both the Okanagan and Similkameen River valleys. Remaining natural habitat in the southern Okanagan Valley is under increasing threat from urban growth and agriculture, particularly conversion of hillsides for vineyards (Bezener *et al.* 2004; Hall 2009; COSEWIC 2012).

The losses of natural habitat may be buffered somewhat by the increased availability of human-modified habitats that support Mormon Metalmarks. Gravel pits, utility corridors, and embankments along roads and railways can provide suitable dry, unstable slopes that maintain the pioneering vegetation that includes their larval host plant and nectar sources. For example, the historical construction of the railway along the base of the gravel ridge in Keremeos may have dramatically increased the abundance of Snow Buckwheat (Kondla *et al.* 2000).

Habitat modelling by the BC Ministry of Environment (unpublished data) has identified potential habitat in the Similkameen and Okanagan valleys, but with too coarse a resolution to adequately capture Mormon Metalmark habitat requirements or to have much predictive power (Dyer pers. comm. 2012). Mormon Metalmarks in BC are known to use microsites within three types of natural biophysical habitat units (Lea *et al.* 1998; Southern Interior Invertebrates Recovery Team 2008). Two units, "barren" habitat and "sagebrush – needle-and-thread grass" habitat, have decreased in area by approximately half due to habitat loss and alteration whereas "bluebunch wheatgrass – Sandberg's bluegrass deep soil" habitat, has not decreased significantly (Southern Interior Invertebrates Recovery Team 2008). In the Okanagan Valley, metalmarks likely occurred primarily in "antelope-brush – needle-and-thread grass" habitat, which has decreased in area by approximately 70% since 1800 (Iverson 2010; Lea 2008). Metalmarks also occur in two human-modified units, "gravel pit" and "dry pasture," which have increased in area slightly.

Prairie Population:

Mormon Metalmark habitat in and around GNP appears stable and relatively abundant with little threat of disturbance due to its remote, harsh nature with few competing land uses (Pruss *et al.* 2008). There is some threat from invasive/non-native weeds and plants within the GNP and adjacent community pastures (see Threat 8 for species information). There are three main vehicle entrances to the park, and it is through these three entrances that invasive plants would be spread (e.g., on car tires or other means). The scope and rate of spread is unknown, and there are ongoing actions to mitigate the spread of these species (Parks Canada 2014).

BIOLOGY

Life Cycle and Reproduction

In Canada, Mormon Metalmarks have a flight period from mid-July to late September, with peak activity from mid- to late August depending on the weather (COSEWIC 2002; Guppy and Shepard 2001; Layberry *et al.* 1998; Wick 2013). There is a staggered emergence of adults, with each adult living 9-11 days during the flight period (Scott 1986a; Wick 2013). Mating typically occurs within three days of adult emergence (COSEWIC 2002) and in BC copulating pairs have been observed from August 11-30 (British Columbia Conservation Data Centre 2014; Foster pers. obs. 2012) and from August 17- 24 in SK (Peterson *et al.* 2010). During courtship males perch in hillside depressions to await females; the male chases the female, they typically land and then copulate (Scott 1986b). Adults lay eggs in August or September.

Most of the behavioural information on Mormon Metalmark comes from research in SK. In SK, Mormon Metalmarks have been observed laying single eggs in late August directly into cracks in the soil or under small rocks near (<2m) Few-flowered Buckwheat (Wick *et al.* 2012). Hooper (2002) observed a female ovipositing on the lower stems and leaves of larval host plants in SK, but could not find eggs. Elsewhere in its range, fertilized eggs are deposited singly or in clusters of two on leaves at the base of robust host plants (Arnold and Powell 1983; Scott 1986a). Oviposition behaviour for BC populations has not been observed, but they likely lay eggs on Snow Buckwheat leaves as has been reported for adjacent Washington populations (Pyle 2002). The total number of eggs laid by individual females is not known, but six female metalmarks observed in Washington produced a total of 47 eggs (James and Nunnallee 2011).

It is unclear whether eggs or early instar Mormon Metalmark caterpillars overwinter in Canadian populations (Guppy and Shepard 2001; Wick *et al.* 2012). Elsewhere in its range, the larvae are known to hibernate in stems, on flower heads, or under leaf litter of their host plants and emerge in the spring to feed (Arnold and Powell 1983). Larvae were observed in SK from June 4 (4 mm in length, likely a first instar) until July 14 (Peterson *et al.* 2010). In SK, Mormon Metalmark caterpillars are crepuscular and rest during the day in silken shelters at the base of the host plant or adjacent substrate (Peterson *et al.* 2010). Weather seems to influence feeding behaviour and they were not observed feeding at temperatures below 8°C or in rainy conditions (Peterson *et al.* 2010). They are typically solitary foragers, although up to three caterpillars were occasionally observed feeding on the same plant in SK (Peterson *et al.* 2010). Younger instars appear to remain on one plant, but later instars have been observed travelling between larval host plants (Peterson *et al.* 2010). Mormon Metalmark caterpillars pass through five instars (Guppy and Shepard 2001), and sometime around July the last instar larvae form pupae in plant litter at the base of the host plant and emerge as adults in August (COSEWIC 2002). The pupal stage for captive-raised individuals from Utah lasted 10-13 days at room temperature (Davis pers. comm. 2013; Stout pers. comm. 2013).

Physiology and Adaptability

Across its broad range in North America, Mormon Metalmark larvae appear to have adapted to many species of *Eriogonum* host plants (Opler and Powell 1961; Scott 1986b).

Dispersal and Migration

Mormon Metalmarks do not migrate. They appear to have limited colonization potential in fragmented landscapes, primarily due to their high site fidelity, short adult lifespan, and single annual flight period (COSEWIC 2002). They may be sensitive to habitat fragmentation, since their poor dispersal abilities would limit their ability to recolonize suitable habitat following a local extirpation, or to colonize newly available habitats (St. John 1995). Populations are vulnerable to natural stochastic events and extirpations, and recolonization is probably limited at some sites.

Southern Mountain Population:

The maximum dispersal distance was estimated to be 4 km (Desjardins pers. comm. 2014; Crawford *et al.* 2011). Patches of suitable habitat along road and rail corridors may facilitate dispersal. One site at a gravel pit in Keremeos may have been colonized from an existing site approximately 600 m along the same ridge (COSEWIC 2002; Dyer pers. comm. 2012). Based on genetic analysis, some Mormon Metalmark sites in the Keremeos area may be reproductively isolated from each other, and the urban areas of Keremeos may act as a barrier preventing individuals from dispersing to the nearest sites west of the town (Crawford *et al.* 2011). Two sites on the western bank of the Similkameen River south of Keremeos may be separated from the nearest other sites due to the large amount of intervening agricultural and urban areas, as well as the river itself (Crawford *et al.* 2011), which is approximately 30-70 m across in this area. Many of the occupied sites are separated by relatively long distances (i.e., >5 km).

Prairie Population:

The maximum dispersal distance for a 2011 mark-recapture study (Wick unpubl. data) and the only individual recaptured more than 1 km from the point of initial capture, was a male that moved 2120 m in five days. For the 199 recaptures (of 885 initially marked), the median distance moved was 60 m for females and 34 m for males, over a median time frame of 5.2 and 4.0 days respectively.

In California, a mark-recapture study of the subspecies *Apodemia mormo langei*, recorded the maximum observed lifetime dispersal distance observed at 600 m, but the average lifetime dispersal distance was only 49 m for males and 64 m for females (Arnold and Powell 1983).

Interspecific Interactions

Mormon Metalmark larvae require *Eriogonum* spp. (Polygonaceae) for feeding and the eggs or early instar larvae may require buckwheat stems or leaf litter for overwintering (COSEWIC 2002). Larval feeding damages *Eriogonum* plants but does not cause plant mortality (Peterson *et al.* 2010). Although Mormon Metalmark is not an essential pollinator of *Eriogonum* spp. or Yellow Rabbitbrush, Okanagan traditional ecological knowledge recognizes the role of the metalmark in helping the Snow Buckwheat (Armstrong 2012).

Metalmarks are not thought to have other critical ecological roles (e.g., food-web dynamics). Both larvae and adults can be locally abundant and may be prey of other insects, bats, small mammals, and birds, or hosts for parasites (COSEWIC 2002). An ambush bug, *Phymata* sp. (Heteroptera: Reduviidae) was observed preying upon a Mormon Metalmark in 2002, with high levels of predation for the site inferred during the ambush bug outbreak that year (COSEWIC 2002). The ambush bug *P. americana metcalfi* is common on Stinking Rabbitbrush in the Keremeos and Osoyoos areas (Punzalan 2012), and was observed preying upon a Juba Skipper (*Hesperia juba*) nectaring on a Stinking Rabbitbrush plant near a known metalmark site in 2012 (Foster pers. obs. 2012). While predation is a naturally occurring process, high levels of predation may threaten individual sites that are stressed from habitat fragmentation and degradation, particularly during bug outbreaks.

Southern Mountain Population:

Adults primarily nectar on Snow Buckwheat and Stinking Rabbitbrush. Snow Buckwheat begins flowering mid-August so metalmarks that emerge in early August must depend upon other nectar sources, particularly Stinking Rabbitbrush. Metalmarks have occasionally been observed nectaring on White Clematis (*Clematis ligusticifolia*), Knapweed (*Centaurea* spp.), Big Sagebrush (*Artemisia tridentata*), and Common Yarrow (*Achillea millefolium*) (British Columbia Conservation Data Centre 2014).

Prairie Population:

The quality of metalmark habitat is probably influenced by the density and quality of nectar sources (Pruss *et al.* 2008). In SK, the availability of Few-flowered Buckwheat as a nectar source is partly habitat-dependant (Hooper 2002). On clay slopes and partially bare valley bottoms, where soil has washed down from the slopes, the plant blooms in mid-June. On bare slopes of poorer grey shale-like soil where metalmarks are most frequently observed, it blooms later, overlapping their flight period. As buckwheat flowers senesce in mid-September, metalmarks nectar on rabbitbrush.

POPULATION SIZES AND TRENDS

Sampling Effort and Methods

Southern Mountain Population:

To date, the purpose of most surveys has been to record the species' presence (coordinates), nectar source, and habitat data (see Search Effort). One mark-recapture study occurred in conjunction with sampling for genetics studies (using wing clipping) (Crawford *et al.* 2011; Mandryk 2005).

A mark-recapture study (conducted by Desjardins unpubl. data) occurred in 2006 (17 days between August 9 – September 3), 2007 (8 days between August 9 – 24) and 2008 (12 days between August 12 – 30) (Desjardins unpubl. data). Adults were marked with individual codes and coordinates recorded for each capture/recapture.

Prairie Population:

Survey methods have been generally similar to BC efforts, with the exception of a mark-recapture study conducted by Wick (2013). A total of 885 Mormon Metalmarks were caught in August 2012 at seven sites in Grasslands National Park and Val Marie Community Pasture, uniquely marked, and released. Over the next 28 days, there were 142 recaptures, which permitted the calculation of population estimates at each site using the Jolley-Seber method and the MARK computer program (White 2012).

Abundance

Southern Mountain Population:

A mark-recapture study in 2005 (Mandryk 2005) was conducted at the Red Bridge site (north of Bullock Creek) concurrently with a standard visual survey (Yelland and Noble 2005). The site was visually surveyed on 19 days, with a maximum daily count of 60 to 87 individuals recorded during peak flight period (August 11-19). The five mark-recapture estimates for the same flight period were 3 to 6 times higher, ranging from 161 to 319 individuals, which suggest visual surveys significantly underestimate the number of Mormon Metalmarks (Mandryk 2005).

In 2006, the maximum daily total number of metalmarks observed at individual sites ranged from 0 to 222, with the greatest number of observed in 2006 at Keremeos (Table 1). Total population size is difficult to determine, but using the maximum daily total for the minimum population size at a site, at least 671 metalmark individuals were observed during all survey dates in 2006 (Table 1).

Visual surveys at most known sites in 2006 recorded approximately 500 metalmarks over the entire season, which suggest a total population of 1500-3000 individuals (Dyer 2006b). A couple of new sites were not surveyed in 2006 and several sites have since been recorded, suggesting the Southern Mountain Population is at least 2000 metalmarks in 2006.

The data from the mark-recapture study in Keremeos in 2006, 2007 and 2008 have not been analyzed or published (Desjardins pers comm. 2014). Results from preliminary analysis suggest the data are not sufficient to make population estimates. Fieldwork and information gathered on dispersal distance (see Crawford *et al.* 2011; Desjardins pers. comm. 2014) suggest that assumptions needed to make statistical analysis are not possible (e.g., the Mormon Metalmark population is not closed, and likely has immigration/emigration and significant births/deaths within the population (Krebs 1999)). In addition, survey effort, transects and survey area are not consistent throughout the study or across years, and there are many days when weather impeded butterfly activity. Thus, it is not possible to calculate population at this time (Desjardins pers. comm. 2014).

Prairie Population:

The total number of individuals is believed to be "quite small", but there is insufficient information to estimate population size or trend (Pruss *et al.* 2008). The population was estimated at less than 1000 individuals in 2002 when 6 sites were known (Hooper 2002; COSEWIC 2002). Since then, the number of known sites has increased to 88 (Wick 2013). A total of 885 metalmarks were individually marked at seven sites in 2012 by Wick, and population estimates from recaptures suggest a combined population for those seven sites of approximately 1800 to 3500 individuals based on lower and upper 95% confidence intervals (Wick 2013). Given that these seven sites represent only a small fraction of the known sites, there may potentially be at least several thousand individuals in the Prairie Population.

Fluctuations and Trends

Natural population fluctuations for butterflies are a result of numerous factors (e.g., parasites, predators, etc.) including the previous years' weather. Populations exhibit variability in local distribution and abundance and act as metapopulations among habitat patches. There is little information on population fluctuations and trends for both the Southern Mountain and Prairie populations. There is no evidence to indicate that this species was ever abundant or widespread in BC (Southern Interior Invertebrates Recovery Team 2008) or SK (Pruss *et al.* 2008). The populations in both provinces may undergo fluctuations in size (Table 1) (COSEWIC 2002; Pruss *et al.* 2008), but this is difficult to quantify or confirm due to variability in the timing, intensity, sites surveyed, and low detection during surveys. The population totals don't reach high numbers, even during years when extensive surveys have been completed. In addition, most of the occupied habitat occurs on eroding slopes, which may be limited in distribution or separated by long distances. For this reason, Mormon Metalmark populations may be vulnerable to natural stochastic events and extirpations, and re-colonization probability may be low (COSEWIC 2002).

In 2002, approximately 65 Mormon Metalmarks were observed at six sites in BC and the population estimated to be less than 100 breeding adults (COSEWIC 2002). Mormon Metalmark is extirpated from historic sites from Okanagan valley near Oliver and Okanagan Falls. The size and extent of these populations and the reasons for their disappearance are unknown (COSEWIC 2002). The overall population trend in BC is thought to be declining given the loss of all but one known populations in the Okanagan Valley. Although there are now more known occupied sites in the Similkameen Valley (and a new one near Spotted Lake in the Okanagan Valley) than were reported in the 2002 COSEWIC status report, it is believed that these sites represent pre-existing populations were recently discovered due to increased survey effort, rather than "new" populations established since 2002. Thus, given the loss of documented historical populations in the Okanagan Valley, there is an overall (if largely undocumented) declining trend in overall population size.

The 2002 status report suggested there is a stable or expanding area of occupation since 1995, but that total population counts had declined. This appeared to be based at least part on the dynamics of the Keremeos population. At the time of the report, the maximum daily totals at this best known site had declined to 40 or 50 individuals from a high of 350 in 1995. There had been some dispersal along the ridge, but at the time it appeared that only nearest "daughter" sites were extant. However, over 200 Mormon Metalmarks were observed in 2006 at the gravel pit farther west along the ridge, approximately 800 m from the original site. This gravel pit had the greatest number of metalmarks observed in 2012 (Foster pers. obs. 2012) and appears to be more active than the original site in recent years (Dyer pers. comm. 2012). The reason for this apparent shift is unknown; since habitat at the original site still appears suitable (these two sites are mapped as one polygon by the British Columbia Conservation Data Centre).

Preliminary GIS simulations for Mormon Metalmarks around Keremeos indicate that the Southern Mountain Population is viable if habitat is protected, with long-term population predicted to fluctuate around as few as 1500 individuals (Southern Interior Invertebrates Recovery Team 2008). The Mormon Metalmark sites south of Cawston, in Olalla, and at the most westerly site along the Similkameen River are only viable in the long term if they are assumed to be much larger than current data suggest, or if dispersal rates are much greater than currently understood (Southern Interior Invertebrates Recovery Team 2008).

Rescue Effect

Southern Mountain Population:

Rescue effect from US populations may occur. The closest US populations are approximately 20 km south of the international border at Toats Coulée (WA), where at least ten individuals were collected in 2008 (Proshek *et al.* 2013). The nearest known Canadian occurrence is southwest of Richter Mountain (Site #3, Figure 6) approximately 2 km north of the international border. Metalmarks were last documented there in 2006, and were also observed at Frank Lake (Site #14) as recently as 2012, approximately 5 km to the northeast (Table 1). Populations from southern BC are genetically similar to adjacent ones in northern Washington along the Similkameen and Okanagan rivers, which suggests that there may be undocumented populations in between that could permit successful dispersal and gene flow (Proshek *et al.* 2013), but recent survey effort is lacking in adjacent areas of northern Washington.

Prairie Population:

Mormon Metalmarks in SK were genetically similar to those in adjacent Montana, suggesting immigration and dispersal are likely ongoing, and perhaps habitat may recolonize naturally should local extirpation occur (Proshek *et al.* 2013). The nearest Mormon Metalmark site in Montana is approximately 50 km south of GNP, near the junction of the Frenchman and Missouri rivers (Kohler pers. comm. 2013). This is farther than known dispersal distance capabilities of Mormon Metalmarks, suggesting there may be habitat and/or populations in between. Where Montana populations are found, they are generally with good numbers (Kohler pers. comm. 2013).

THREATS AND LIMITING FACTORS

Southern Mountain Population:

Habitat loss and degradation is the primary threat to Mormon Metalmarks (Southern Interior Invertebrates Recovery Team 2008). However, research is required to assess the potential threats to habitat from utility and transportation corridor expansion and maintenance, aggregate quarrying, invasive weeds, disposal of agricultural debris at adjacent property, wild fire, pesticide use, and livestock impacts on all life stages (Southern Interior Invertebrates Recovery Team 2008).

Prairie Population:

The majority (approximately 80-90%) of known sites are within the current or proposed boundary of Grassland National Park, and are not directly threatened by human activities. The remaining sites are on the Beaver Valley and Val Marie community pastures. Agriculture Canada is currently divesting Prairie Farm Rehabilitation Administration (PFRA) community pastures to provincial control, and the province of Saskatchewan will assume control in the next few years. These lands could ultimately be sold to private individuals or commercial interests, with potential impacts on Mormon Metalmark populations. Habitat loss or degradation was the highest ranked in the provincial recovery plan due to the potential for severe localized effects, although the probability of occurrence is low (Pruss *et al.* 2008).

Potential threats are described below using categories outlined in the International Union of Conservation Networks (2013) threats assessment calculator.

Residential or Commercial Development

1.1 Housing and urban areas; 1.2 Commercial and industrial areas and 1.3 Tourism and recreation areas are all considered secondary threats to the Southern Mountain Population. Most metalmark sites are on steep, eroding slopes and not prime sites for development. Regardless, at least 14 sites are on private land. Recent landscaping and planting of ornamental trees and shrubs by the town of Keremeos for aesthetic purposes resulted in the loss of approximately 80-100 m^2 of habitat before these efforts were stopped (COSEWIC 2002; Dyer pers. comm. 2013).

Agriculture and Aquaculture

Annual and perennial non-timber crops (Threat 2.1)

Southern Mountain Population:

One of the largest sites with the greatest numbers of metalmarks (north of Bullock Creek; Figure 9) is gently sloping and potentially suitable for pasture, vineyards, or other agricultural development. Disposal of agricultural debris may be a problem at one site (Southern Interior Invertebrates Recovery Team 2008). Historically, the conversion of habitat to vineyards or other agricultural fields (see Habitat Trends) has likely been a contributing factor to population fragmentation. The Spotted Lake (Okanagan Valley) and most sites in the Similkameen Valley are on roadside embankments or on slopes that are largely unsuitable for agriculture (too steep or eroding) and not likely impacted by agriculture (conversion or intensification).

Livestock farming and ranching (Threat 2.3)

Southern Mountain Population:

Livestock grazing occurs at a number of sites, although the intensity or frequency is unknown.

Prairie Population:

Sites outside the current Grasslands National Park are grazed. Where grass is abundant, *Eriogonum* does not appear heavily grazed (Foster pers. obs. 2012; Hooper 2002) although, in a heavily grazed pasture in SK, Few-flowered Buckwheat was grazed close to the ground (Hooper 2002). Ranching activities (e.g., winter-feeding, salt blocks or calving sites) could potentially impact undocumented metalmark sites on private lands within the proposed park boundary

Under drought conditions when alternate forage is limited, cattle grazing on *Eriogonum* could result in increased mortality or reduced fitness of metalmarks in BC or SK. These activities may permanently or temporarily destroy habitat, including plants that provide food or egg-laying sites, and may destroy adults, eggs, or larvae (Southern Interior Invertebrates Recovery Team 2008).

Energy Production and Mining

Mining and Quarrying (Threat 3.2)

Gravel extraction is a threat to the Southern Mountain Population. There is an active gravel pit in Keremeos where some of the highest abundance counts have been recorded. Gravel extraction operations maintain a disturbed habitat, which overall maintains the conditions for Snow Buckwheat to thrive. Conversely, gravel extraction may destroy habitat and host plants depending on the scope and severity at the site. Less extensive gravel extraction also occurs, or has occurred, at four additional metalmark sites in BC.

Transportation and Service Corridors

Roads and railroads. (Threat 4.1)

Roadside maintenance and mortality from traffic are threats to the Southern Mountain Population only.

Road maintenance:

Disturbance from the creation and maintenance of road, rail, and utility corridors has likely created disturbed, eroding habitats suitable for Mormon Metalmarks. Construction and maintenance activities occur along Highway 3 and potentially affect nine sites, including those with the highest population densities. Activities such as natural gas line installment or repair, ditch maintenance to remove eroded debris and re-contour ditch slopes, vegetation mowing or herbicide spraying for noxious weed control, and vegetation removal around power poles to reduce wildfire concerns may destroy eggs or larvae, or permanently or temporarily remove plants that provide food or egg-laying sites. These threats potentially occur all along this transportation and utility corridor, but the probability of impacts at specific sites is unknown (Southern Interior Invertebrates Recovery Team 2008).

Mortality from traffic:

At least nine sites along the Highway 3 road allowances of the Similkameen corridor may experience this threat. No statistics are available for the stretch of highway through the Keremeos area; however, in August (peak travel month) ~5000 vehicles per day travel along Highway 3 (statistic recorded near Hope, about an hour west of Keremeos) and ~8000 vehicles per day on Highway 3A/97 south of Penticton in the Okanagan Valley (BC Ministry of Transportation and Infrastructure [MoTI] 2012). August traffic volumes along Highway 3 have remained relatively constant from 2004-2012 and may represent a low-level but relatively constant source of mortality for adult Mormon Metalmarks.

During a 2005 survey, Mormon Metalmarks along Highway 3 were more abundant on slopes that were below the road's edge (Yelland and Noble 2005). Vehicle traffic was found to kill significant numbers of butterflies in an Illinois study (McKenna *et al.* 2001), and although roads were not a serious barrier to butterfly movement, vehicles killed up to 7% of adult butterflies from some English populations (Munguira and Thomas 1992).

Human Intrusions and Disturbance

Recreational activities (Threat 6.1)

All-terrain vehicle (ATV) use is a secondary threat at a few Southern Mountain Population sites (Southern Interior Invertebrates Recovery Team 2008), and is listed as a threat to the Prairie Population (Pruss *et al.* 2008). However, no evidence of damage to host plants was observed during 2012 fieldwork in BC, and ATV use is restricted in GNP.

Natural System Modifications

Fire and Fire suppression (Threat 7.1)

Wildfire is considered a threat to both BC (Southern Interior Invertebrates Recovery Team 2008) and SK populations (Pruss *et al.* 2008), but it is unlikely to have widespread effects. Fires are actively suppressed in the heavily developed Similkameen Valley in BC, and some disturbance by wildfire may actually benefit metalmarks by reducing competing woody vegetation. Prairie fires are relatively common in Grasslands National Park but the loss of metalmark habitat by wildfire is unlikely because badland habitat is sparsely vegetated (Pruss *et al.* 2008).

Invasive and Other Problematic Species and Genes

Invasive non-native/alien species (Threat 8.1)

Southern Mountain Population:

Eurasian weeds such as Diffuse Knapweed (*Centaurea diffusa*), Dalmation Toadflax (*Linaria dalmatica*) and Downy Brome (*Bromus tectorum*) occur in many sites and may reduce the size and density of host plants (COSEWIC 2002).

Prairie Population:

Yellow Sweet Clover (*Melilotus officinalis)* has invaded badland habitat within Grasslands National Park (Michalsky *et al.* 2005) but it is not known if it has impacted metalmark habitat (Pruss *et al.* 2008) or if the plant is highly competitive with metalmark host or nectar plants. The rate of spread or spatial areas in which the plant has invaded is not well quantified. Other invasive plants include Leafy Spurge (*Euphorbia esula*) and Crested Wheatgrass (*Agropyron cristatum*). Ongoing restoration activities within the park include the application of herbicide and seeding to re-vegetate areas dominated by Crested Wheatgrass (Parks Canada 2014).

Pollution

Agricultural and forestry effluents (Threat 9.3)

Southern Mountain Population:

Approximately half of the sites are directly adjacent to agricultural fields and pesticide drift is a potential risk.

Prairie Population:

Agrochemical drift, particularly of pyrethroids or chlopyrifos used during grasshopper outbreaks, potentially threatens sites located on the periphery of Grassland National Park (no spraying occurs in the park) or adjacent private lands (Pruss *et al.* 2008).

Climate Change and Severe Weather

Droughts (Threat 11.2)

Climate change, particularly an increase in the frequency and intensity of extreme and periodic climatic events such as droughts, has been identified as a potential threat for both the Southern Mountain (Southern Interior Invertebrates Recovery Team 2008) and Prairie populations (Pruss *et al.* 2008). Decreased precipitation and increased mean annual temperatures associated with climate change (Lemmen *et al.* 1997) might reduce host plant fitness and abundance, and affect bloom times of floral resources.

Storms and flooding (Threat 11.4)

Small, isolated populations of metalmarks are particularly vulnerable to stochastic events such as hailstorms or severe frost.

Limiting Factors

Factors that may limit Canadian populations of Mormon Metalmarks are:

- small colony size and low detectability at sites in both BC and SK.
- host plant specificity, it appears that host plants need to be of a certain size and/or age before metalmarks are present, although the specifics of this correlation are unstudied and unknown.
- specific habitat requirements for both the host plant(s) and butterfly.

Number of Locations

Southern Mountain Population:

Based on threats from habitat degradation to existing sites (threat of development; gravel extraction and ongoing succession by invasive and non-native plants at most sites, and agricultural debris deposited from adjacent properties onto metalmark habitat), there are 4 - 5 locations.

Prairie Population:

The primary threats appear to be invasive non-native/native plant succession, which occurs at variable rates depending on the site, and suggesting 3 locations (based on three main entrance roads to Grasslands National Park), depending on the unknown ability of the butterfly to recolonize sub-sites in years when invasive vegetation may be reduced (in area) due to drought. The rate and spread of invasive species is unknown and likely beyond the ten-year time assessment for this status report.

PROTECTION, STATUS AND RANKS

Legal Protection and Status

Mormon Metalmark is listed as Endangered (Southern Mountain Population) and Threatened (Prairie Population) under the federal *Species at Risk Act* (SARA). A provincial recovery strategy has been prepared for the Southern Mountain Population (Southern Interior Invertebrates Recovery Team 2008) and a federal recovery strategy has been developed for the Prairie Population (Pruss *et al.* 2008). Critical habitat is not defined for either population. A residence description for the Prairie Population was posted to the federal SARA Public Registry in 2010.

Southern Mountain Population:

The provincial recovery strategy has not been federally adopted and is not posted on the SARA Public Registry. The provincial recovery goal is to "maintain at least one viable population in secure habitat within the species' historic range in British Columbia". Long term (>100 years) habitat securement will require a stewardship approach that engages the voluntary cooperation of landowners and managers on a variety of land tenures. The provincial recovery objectives are to: 1) secure a minimum of 13.5 ha (90%) of the known, currently occupied habitat in the Similkameen area by 2012; 2) develop and initiate a prioritized research program by 2009 and complete research by 2012 to address important knowledge gaps including population size and distribution, habitat requirements, dispersal capabilities and potential threats; and 3) determine the feasibility of re-establishing at least one viable population of Mormon Metalmarks in secure habitat in the Okanagan valley by 2011. As of January 2013, these objectives are partially met.

Mormon Metalmark is listed as *Identified Wildlife* under the *BC Forest and Range Practices Act* and it is possible to protect known sites and habitat for this species within Wildlife Habitat Areas on provincial Crown land. To date, no Wildlife Habitat Areas have been designated (Heron pers. comm. 2013). Invertebrates listed by COSEWIC as *threatened, endangered* or *extirpated* will be protected through the provincial *Wildlife Act* and *Wildlife Amendment Act* once the regulations listing these species under provincial legislation are completed.

Prairie Population:

The federal recovery strategy and residence description for the Prairie Population are posted on the SARA public registry. The federal recovery goal is to "maintain suitable habitat and ecological linkages within the known range of the Prairie population of the Mormon Metalmark". The federal recovery objectives include: 1) surveys to assess and map all known occupied metalmark habitat; 2) determine if metalmarks exist outside their known range; 3) determine adult population size of known colonies 4) identify and implement best management practices and stewardship agreements; 5) determine the extent of dispersal within SK and adjacent Montana; and 6) integrate metalmark efforts within broader conservation initiatives. Mormon Metalmark is not listed under the Saskatchewan *Wildlife Act* in (SK CDC 2012).

Non-Legal Status and Ranks

Global Status Rank G5 (Secure; NatureServe 2012).

Canada National Status Rank N1 (critically imperilled),

BC Status Rank S1 (critically imperilled) (British Columbia Conservation Data Centre 2014)

SK Status Rank S1 (Saskatchewan Conservation Data Centre 2014).

General Status Program (Canada) ranked At Risk (1) and Sensitive (3) in both BC and AB

United States National Status Rank N1

Washington Status Rank S4 (Apparently Secure)

Montana S3S5 in Montana, and S5 (Secure) in Colorado S5

All other states where the species occurs SNR/SU

The conservation status rank for the larval host plant of the Prairie Population (*E. pauciflorum*) is Vulnerable (S3) in SK (Saskatchewan Conservation Data Centre 2014); and the Southern Mountain Population (Snow Buckwheat) is Apparently Secure (S4) in BC (British Columbia Conservation Data Centre 2014).

Habitat Protection and Ownership

Southern Mountain Population:

Land ownership is a mixture of BC Crown land (9 sites), those owned/managed by BC Ministry of Transport along Highway 3 (13 sites), local government (Town of Keremeos, 1 site), First Nations' reserves (unknown number of sites), and private lands (13 sites) (Table 3). No known BC sites are within provincial parks or protected areas, although some private landowners are supportive of metalmark conservation (Dyer pers. comm. 2012). Sites are defined as a continuous patch of metalmark habitat polygon. Populations at sites likely mix with other sites, although it is unknown to what extent.

Table 3. Land tenure, habitat type, and main threats applicable to Mormon Metalmark sites in British Columbia.

Site #	Year(s) recorded	Extirpated or Extant	Habitat Type	Land Ownership				Threats[2]				
				Prov. Crown	Local Government (Private)	Private	BC Ministry of Trans. (Road Allow.)	Ranching (2.3)	Gravel Extraction (3.2)	Road Mainten. (4.1)	Utility Mainten. (4.2)	Invasive Plant Species (8.1)
Total Number of Sites				9	1	13	13	7	5	10	1	15
1	Confidential sites											
2a	2003-2012	Extant	natural slope, now with gravel pit	X		X	X		H	L		L
2b	1990-2008	Extant?	modified natural slope	X	X	X	X			M	L	L
3a	1995	Extirpated?	road embankment	X				L				L
3b	2005-2006	Extant?	road embankment				X			M		L
3c	2005-2007	Extant?	road embankment	X		X	X	L				
3d	2005-2008	Extant?	road embankment			X		L				
4	1995	Extirpated?	road embankment				X					L
5a	1995-2012	Extant	road embankment				X			M		L
5b	2003-2008	Extant?	road embankment				X			M		L
6	2003-2012	Extant?	road embankment	X		X			M	M		L
7	2001-2009	Extant?	natural slope			X						
9a	2005	Extirpated?	natural slope			X						L
9b	No date	Extirpated?	natural slope			X						

Site #	Year(s) recorded	Extirpated or Extant	Habitat Type	Land Ownership				Threats[2]				
				Prov. Crown	Local Government (Private)	Private	BC Ministry of Trans. (Road Allow.)	Ranching (2.3)	Gravel Extraction (3.2)	Road Mainten. (4.1)	Utility Mainten. (4.2)	Invasive Plant Species (8.1)
9c	2003-2012	Extant	natural slope and road embankment	X		X	X		M	M		L
9d	2001-2009	Extant?	road/rail embankment				X					L
9e	2003-2008	Extant?	road/rail embankment			X						L
9f	2004-2006	Extant?	road/rail embankment	X			X					L
9g	No date	Extirpated?	natural slope				X					
9h	2003-2006	Extant?	natural slope	X								
10	1998-2012	Extant	natural slope, now with gravel pit			X			L			
12	2005-2012	Extant	road embankment			X		M		M		L
13a	2007-2008	Extant?	natural slope			X		L				
13b	2007-2008	Extant?	natural slope	X				L				
14	2009-2012	Extant	road embankment				X			M		
15	2009-2012	Extant	natural slope				X	M				
16	1995-2012	Extant	natural slope, now with gravel pit						M	M		L

[1] BC Conservation Data Centre (2012) element occurrence (EO) number (note: there are missing numbers); letters have been added to differentiate separate polygons within the same EO

[2] based on IUCN Threats Calculator L=low; M=Medium; H=High

Table 4. The threat classification for Southern Mountain Population. The classification below is based on the IUCN-CMP (World Conservation Union–Conservation Measures Partnership) unified threats classification system. For a detailed description of the threat classification system, see the CMP website (CMP 2010). Threats may be observed, inferred, or projected to occur in the near term. Threats are characterized here in terms of scope, severity, and timing. Threat "impact" is calculated from scope and severity. For information on how the values are assigned, see Master *et al.* (2009).

Mormon Metalmark (*Apodemia mormo*) Southern Mountain Population				
Date: October 3, 2013				
Assessed by: Jennifer Heron (Arthropods SSC Co-chair), Rob Foster (status report author), Allan Harris (status report author) and Orville Dyer (BC Ministry of Forests, Lands and Natural Resource Operations.				
		Level 1 Threat Impact Counts		
Threat Impact		**high range**	**low range**	
A	Very High	0	0	
B	High	0	0	
C	Medium	2	2	
D	Low	1	1	
	Calculated Overall Threat Impact:	Medium	Medium	

Threat		**Impact (calculated)**		**Scope (next 10 Yrs)**	**Severity (10 Yrs or 3 Gen.)**	**Timing**	**Comments**
1	Residential and commercial development		Negligible	Negligible (<1%)	Moderate (11-30%)	Low (Possibly in the long term, >10 yrs)	
1.1	Housing and urban areas		Negligible	Negligible (<1%)	Moderate (11-30%)	Low (Possibly in the long term, >10 yrs)	Most metalmark sites are on loose gravelly slopes and not within areas targeted for urban development. There is always the possibility unchecked sites could become developed.
1.2	Commercial and industrial areas		Negligible	Negligible (<1%)	Moderate (11-30%)	Low (Possibly in the long term, >10 yrs)	Most metalmark sites are not within areas likely to be developed for commercial purposes. There is always the possibility unchecked sites could become developed.
1.3	Tourism and recreation areas		Negligible	Negligible (<1%)	Moderate (11-30%)	Low (Possibly in the long term, >10 yrs)	Most metalmark sites are not within areas likely to be developed for recreational purposes. There is always the possibility unchecked sites could become developed.
2	Agriculture and aquaculture	D	Low	Small (1-10%)	Slight (1-10%)	Moderate (Possibly in the short term, < 10 yrs)	
2.1	Annual and perennial non-timber crops		Not a Threat (in the assessed timeframe)	Small (1-10%)	Slight (1-10%)	Low (Possibly in the long term, >10 yrs)	Conversion to agriculture in many sites is unlikely, mainly because the habitat is sloped, gravelly and unsuitable for cultivation.
2.2	Wood and pulp plantations						Not applicable.
2.3	Livestock farming and ranching	D	Low	Small (1-10%)	Slight (1-10%)	Moderate (Possibly in the short term, < 10 yrs)	Grazing and ranching is ongoing at 7 sites
2.4	Marine and freshwater aquaculture						Not applicable.
3	Energy production and mining	C	Medium	Large (31-70%)	Moderate (11-30%)	High (Continuing)	
3.1	Oil and gas drilling						Not applicable.

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
3.2	Mining and quarrying	C	Medium	Large (31-70%)	Moderate (11-30%)	High (Continuing)	Possibility of gravel extraction at roadside sites; road expansion along Highway 3 sites.
3.3	Renewable energy						Not applicable.
4	Transportation and service corridors		Medium	Large (31-70%)	Moderate (11-30%)	Moderate (Possibly in the short term, < 10 yrs)	
4.1	Roads and railroads	C	Medium	Large (31-70%)	Moderate (11-30%)	Moderate (Possibly in the short term, < 10 yrs)	At least ten sites are adjacent to road right-of-ways, and possibly impacted from road maintenance or expansion.
4.2	Utility and service lines						Not applicable.
4.3	Shipping lanes						Not applicable.
4.4	Flight paths						Not applicable.
5	Biological resource use						
5.1	Hunting and collecting terrestrial animals						Not applicable.
5.2	Gathering terrestrial plants						Not applicable.
5.3	Logging and wood harvesting						Not applicable.
5.4	Fishing and harvesting aquatic resources						Not applicable.
6	Human intrusions and disturbance						
6.1	Recreational activities						Not likely to be impacted from recreation.
6.2	War, civil unrest and military exercises						Not applicable.
6.3	Work and other activities						Not applicable.
7	Natural system modifications	D	Low	Pervasive (71-100%)	Slight (1-10%)	Unknown	
7.1	Fire and fire suppression	D	Low	Pervasive (71-100%)	Slight (1-10%)	Moderate (Possibly in the short term, < 10 yrs)	Fires may impact some sites (e.g., careless discard of cigarettes included). Fire suppression not likely a factor.
7.2	Dams and water management/use						Not applicable.
7.3	Other ecosystem modifications						Not applicable.
8	Invasive and other problematic species and genes			Pervasive (71-100%)	Unknown	High (Continuing)	

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
8.1	Invasive non-native/alien species			Pervasive (71-100%)	Unknown	High (Continuing)	Invasive vegetation is present at most sites; however, most sites are periodically disturbed, steep and vegetation does not grow quickly.
8.2	Problematic native species			Pervasive (71-100%)	Unknown	High (Continuing)	Native vegetation is present at most sites and shrubs may grow higher than host plants (and shade out host plants); however, most sites are periodically disturbed or in areas where gravel unravels or vegetation does not grow quickly.
8.3	Introduced genetic material						Not applicable.
9	Pollution			Small (1-10%)	Unknown	Moderate (Possibly in the short term, < 10 yrs)	
9.1	Household sewage and urban waste water						Not applicable.
9.2	Industrial and military effluents						Not applicable.
9.3	Agricultural and forestry effluents			Small (1-10%)	Unknown	Moderate (Possibly in the short term, < 10 yrs)	Agricultural areas adjacent to known sites (e.g., a few sites in the Keremeos area) may overspray onto metalmark habitats. Roadside herbicide application is possible.
9.4	Garbage and solid waste						Not applicable.
9.5	Air-borne pollutants						Not applicable.
9.6	Excess energy						Not applicable.
10	Geological events						
10.1	Volcanoes						Not applicable.
10.2	Earthquakes/tsunamis						Not applicable.
10.3	Avalanches/landslides						Not applicable.
11	Climate change and severe weather		Not a Threat (in the assessed timeframe)	Pervasive (71-100%)	Unknown	Low (Possibly in the long term, >10 yrs)	
11.1	Habitat shifting and alteration		Not a Threat (in the assessed timeframe)	Pervasive (71-100%)	Unknown	Low (Possibly in the long term, >10 yrs)	Climate change may cause timing of host plant and butterfly life cycles to not align.
11.2	Droughts						Not applicable.
11.3	Temperature extremes						Not applicable.
11.4	Storms and flooding						Not applicable.

Table 5. Summary of 2012 Northern Bioscience survey effort at 36 sites in southern British Columbia for Mormon Metalmark. Mormon Metalmark was observed at sites highlighted in green in the table below.

Map Label	Date	Time	Effort (person-minutes)	Approx Survey Area (ha)	Weather	# MM	Habitat
1	Aug 30	17:30	5	1.5	21°C partly sunny, Beaufort 2	0	bare rocky slope; no suitable habitat
2	Aug 28	13:25-13:55	60	0.4	23°C, mainly sunny, Beaufort 2	0	unstable embankment on Hwy 3 ROW with rabbitbrush and snow buckwheat; apparently suitable
3	Aug 28, 30	14:55-15:15; 14:55-15:35	40	2.0	23°C, partly cloudy, Beaufort 2; 27°C, sunny, Beaufort 2	0	long unstable embankment along inactive rail ROW with abundant rabbitbrush and snow buckwheat; ideal-looking habitat
4	Aug 28	12:45-13:00	30	0.2	20°C, partial sun, Beaufort 2	0	unstable embankment on Hwy 3 ROW with rabbitbrush and snow buckwheat; abundant sage and bunchgrass
5	Aug 28	15:20-15:50	60	0.5	23°C, partly cloudy, Beaufort 2	2	unstable sandy/cobble slope on Hwy 3 ROW with rabbitbrush and snow buckwheat; fenced for cattle
6	Aug 28	12:20-12:40	40	2.1	19°C, partial sun, Beaufort 2	0	unstable embankment on Hwy 3 ROW with snow buckwheat and some rabbitbrush
7	Aug 28	11:50-12:15	50	1.2	19°C, partial sun, Beaufort 2	1	unstable embankment on Hwy 3 ROW with rabbitbrush and snow buckwheat
8	Aug 28	11:35-11:45	20	0.7	17°C, partial sun, Beaufort 3	0	small, embankment slope under hydroline ROW with rabbitbrush and snow buckwheat
9	Aug 28	11:00-11:30	60	1.4	17°C, sunny, Beaufort 3	3	unstable embankment on Hwy 3 ROW with rabbitbrush and snow buckwheat
10	Aug 28	16:10-16:50	80	1.8	25°C, mainly cloudy, Beaufort 2	2	fairly stable slope with boulders, sagebrush, bunchgrass, and some rabbitbrush and snow buckwheat; atypical habitat
11	Aug 30	14:45-16:30	110	0.9	25°C partly sunny, Beaufort 2	12	unstable cobble and gravel face of gravel pit in townsite with rabbitbrush and buckwheat
12	Aug 28, 29	9:55-10:40; 17:00-17:15	120	1.6	16°C, overcast, Beaufort 3; 23°C partly cloudy, Beaufort 1	0	unstable embankment by inactive rail ROW w rabbitbrush and snow buckwheat
13	Aug 28, 29	17:10-17:30; 15:40-16:15	90	0.6	25°C, mainly cloudy, Beaufort 3; 26°C partly cloudy Beaufort 1	1	unstable cobble slope at base of hills, with rabbitbrush and snow buckwheat, bunchgrasses

Map Label	Date	Time	Effort (person-minutes)	Approx Survey Area (ha)	Weather	# MM	Habitat
14	Aug 29	13:20-13:35	30	0.6	23°C, sunny, Beaufort 2	0	unstable sandy cobble road embankment on both sides of Hwy 3; abundant buckwheat and some rabbitbrush
15	Aug 30	14:05-14:25	30	0.3	27°C sunny, Beaufort 3	0	unstable sandy cobble road embankment on Hwy 3 ROW with buckwheat and rabbitbrush
16	Aug 30	13:25-13:45	40	1.7	27°C sunny, Beaufort 2	0	small southeast-facing sandy cobble base of slope by secondary road; some buckwheat and rabbitbrush
17	Aug 30	13:10-13:15	10	1.1	26°C, sunny, Beaufort 2	0	small southeast-facing sandy cobble base of slope by secondary road; some buckwheat but no rabbitbrush
18	Aug 29	15:05-15:30	50	0.5	26°C, mainly sunny, Beaufort 2	0	sandy cobble embankment along Hwy 3 ROW with snow buckwheat, rabbitbrush, and sagebrush
19	Aug 29	14:40-14:45	15	0.7	26°C, mainly sunny, Beaufort 2	0	gentle toe slope with some trees, but also buckwheat and rabbitbrush on adjacent rocky slope
20	Aug 29	14:45-15:00	30	0.9	26°C, sunny, Beaufort 2	0	steep rocky slope above Hwy 3 with sagebrush, bunchgrasses and sparse buckwheat and rabbitbrush
21	Aug 29	14:25-14:35	20	0.5	26°C, sunny, Beaufort 2	0	steep rocky slope above road with sagebrush, bunchgrasses and some buckwheat and rabbitbrush
22	Aug 29	14:15-14:25	20	0.4	26°C, sunny, Beaufort 2	0	steep rocky slope above road with sagebrush, bunchgrasses and some buckwheat and rabbitbrush
23	Aug 29	13:50-14:10	40	0.9	26°C, sunny, Beaufort 2	0	steep rocky slope above road with sagebrush, bunchgrasses and some buckwheat and rabbitbrush
24	Aug 29	12:20-12:35	30	0.3	22°C, sunny, Beaufort 2	0	unstable embankment on Hwy 3 ROW with rabbitbrush and sparse snow buckwheat
25	Aug 29	11:55-12:15	40	0.6	21°C, sunny, Beaufort 2	3	fairly stable low embankment along HWY 3 ROW with rabbitbrush and snow buckwheat
26	Aug 29	11:40-11:50	20	0.7	21°C, sunny, Beaufort 2	0	steep eroding silty embankment above Hwy 3 ROW with sparse buckwheat and rabbitbrush; marginal habitat
27	Aug 30	12:15-40	50	1.4	23°C, sunny, Beaufort 2	0	rocky slope with bunchgrass and sagebrush, but also some snow buckwheat and rabbitbrush; cattle ranching
28	Aug 29	11:30-11:35	10	0.2	20°C, sunny, Beaufort 2	0	small eroding slope with some buckwheat and rabbitbrush; marginal site

Map Label	Date	Time	Effort (person-minutes)	Approx Survey Area (ha)	Weather	# MM	Habitat
29	Aug 29	11:15-11:25	20	0.1	20°C, sunny, Beaufort 1	0	small, rocky slope with snow buckwheat sagebrush and some rabbitbrush; cattle grazing
30	Aug 29	9:45-10:35	100	1.1	17°C, sunny, Beaufort 1	3	steep, rocky slope with snow buckwheat, rabbitbrush, and sagebrush
31	Aug 29	10:55-11:05	20	0.2	17°C, sunny, Beaufort 1	0	sandy cobble embankment above road with snow buckwheat, rabbitbrush, and sagebrush
32	Aug 30	11:15-11:30	30	0.4	21°C, sunny, Beaufort 2	0	unstable sandy bankon secondary road with buckwheat and rabbitbrush
33	Aug 30	10:20-10:25	10	0.6	17°C, sunny, Beaufort 2	0	eroding inactive gravel pit, sparse buckwheat and rabbitbrush
34	Aug 30	10:05-10:10	5	0.7	17°C, sunny, Beaufort 2	0	marginal habitat; could not access private land
35	Aug 30	10:00-10:05	5	0.4	17°C, sunny, Beaufort 2	0	marginal habitat; could not access private land
36	Aug 30	9:30-9:45	30	0.2	17°C, sunny, Beaufort 2	0	steep, sandy eroding slope at base of hills with lots of buckwheat

Prairie Population:

Most sites are within GNP or three privately managed cattle ranches within the proposed GNP boundaries (Pruss *et al.* 2008). Eleven sites also occur in AAFC Val Marie Community Pasture (approximately 8% of the habitat, Pruss pers. comm. 2014). The pending transfer of management of this and other federal community pasture back to the province and possibly the private sector could have some risk of conversion of this native grassland habitat.

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BIOGRAPHICAL SUMMARY OF REPORT WRITERS

Robert Foster is co-founder and principal of Northern Bioscience, an ecological consulting firm offering professional consulting services supporting ecosystem management, planning, and research. Dr. Foster has a B.Sc. in Biology from Lakehead University and a D. Phil in Zoology from the University of Oxford. Rob has worked as an ecologist in Ontario for over 20 years, and has authored or coauthored COSEWIC status reports on the Weidemeyer's Admiral, Bogbean Buckmoth, Hop-tree Borer, Laura's Clubtail, Rapids Clubtail, Riverine Clubtail, Northern Barrens Tiger Beetle, Big Sand Tiger Beetle, Crooked-stem Aster, Bluehearts, Georgia Basin Bog Spider, Gibson's, and Drooping Trillium, as well as recovery plans for rare plants, lichens, and odonates.

Allan Harris is a biologist with over 25 years' experience in northern Ontario. He has a B.Sc. in Wildlife Biology from the University of Guelph and a M.Sc. in Biology from Lakehead University. After spending seven years as a biologist with Ontario Ministry of Natural Resources, he co-founded Northern Bioscience, an ecological consulting company based in Thunder Bay, Ontario. Al has authored or coauthored dozens of scientific papers, technical reports, and popular articles, including COSEWIC status reports for Bogbean Buckmoth, Laura's Clubtail, Rapids Clubtail, Northern Barrens Tiger Beetle, Crooked-stem Aster, Bluehearts, Georgia Basin Bog Spider, Hop-tree Borer, Drooping Trillium and Small-flowered Lipocarpha. Al also authored the Ontario provincial status report for woodland caribou, and has authored or coauthored national and provincial recovery strategies for vascular plants and birds.

COLLECTIONS EXAMINED

The following collections were searched for Canadian Mormon Metalmark specimens:

Canadian National Collection of Insects, Arachnids and Nematodes, Ottawa, ON (Sheffield pers. comm. 2012)

E.H. Strickland Entomological Museum, University of Alberta, Edmonton, AB (online search)

J.B. Wallis Museum, University of Manitoba, Winnipeg, MB. (Sharanowski pers. comm. 2012)

N. Kondla, private collection, Rimbey, AB

Royal Alberta Museum, Edmonton, AB. (Buck pers. comm. 2012)

Royal British Columbia Museum, Victoria, BC. (Copley pers. comm. 2012)

Royal Saskatchewan Museum, Regina, SK. (Sheffield pers. comm. 2012)

Spencer Entomological Collection, Beaty Biodiversity Museum, University of British Columbia, Vancouver BC (Needham pers. comm. 2012)